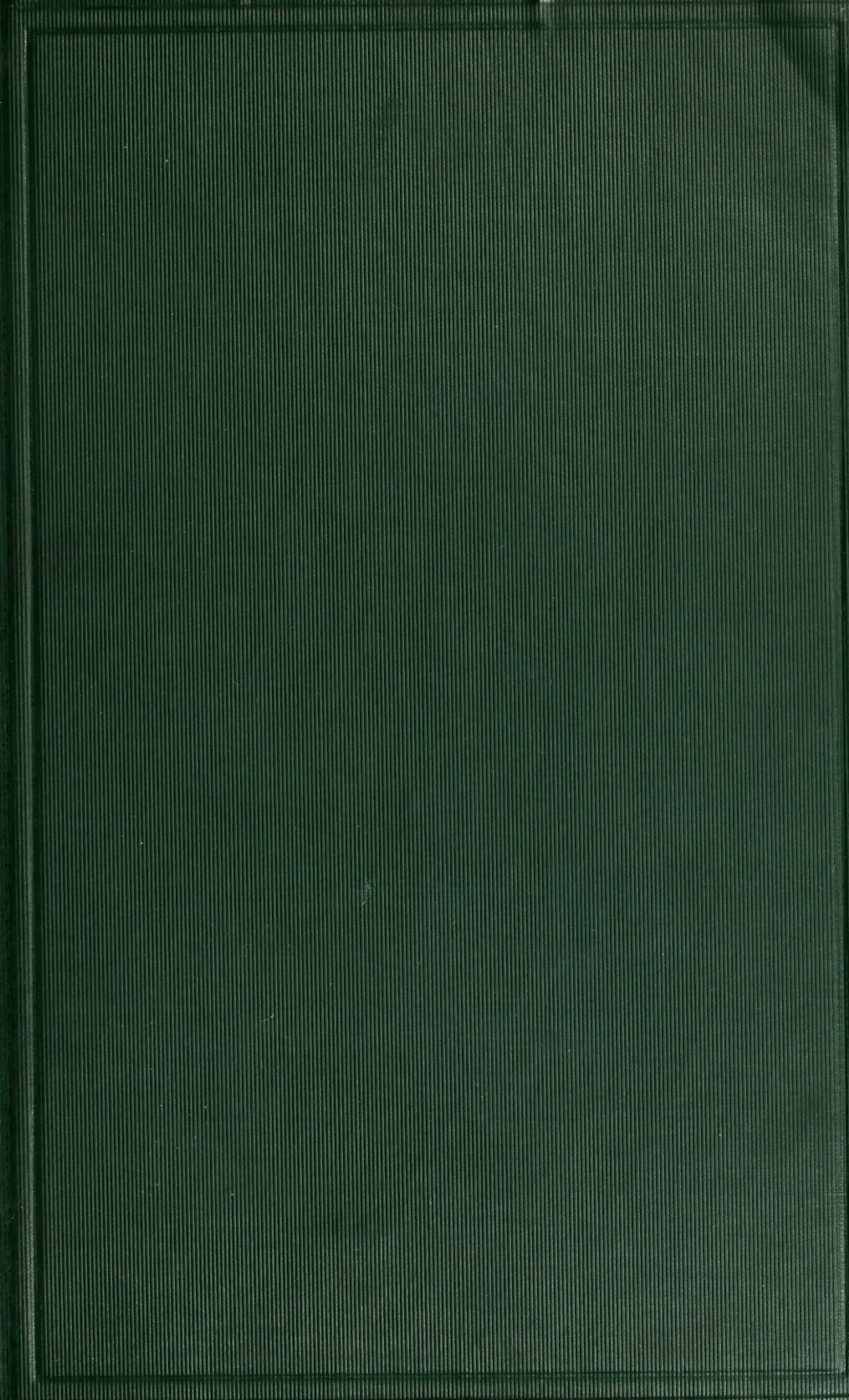




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The Medical Clinics of Chicago

NOVEMBER, 1916

VOLUME 2—NUMBER 3

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The Medical Clinics of Chicago

VOLUME 2

NUMBER 3

CLINIC OF DR. WALTER W. HAMBURGER

COOK COUNTY HOSPITAL

THE MODERN MEDICAL TREATMENT OF CHRONIC ULCER OF THE STOMACH AND DUODENUM

Successful Treatment Dependent on Careful Analysis of Individual Patient.

Value of Repeated Fluoroscopic Examinations as a Control of Treatment and as a Guide in the Healing Process.

Relief of Motor Insufficiency of the Stomach (Delayed Emptying Time) of Paramount Importance in the Successful Management of Ulcer Cases. Its Control by Proper Diet, Bismuth, and Atropin.

Importance of the Mechanism of "Hunger-pain" in Relation to Diagnosis and Treatment. A New Explanation of Pain in Gastric Ulcer Based on Experimental Evidence.

Full Discussion of the Details of Ulcer Management.

THIS patient is a young man, thirty-six years of age, a tea taster by occupation. His present complaint for which he entered the hospital began five years ago, about November or December, 1911. He first noticed a slight *pain* in the epigastrium coming on about 11 or 12 o'clock in the forenoon and relieved by his noon meal. This discomfort would recur about 4 o'clock in the afternoon, and would persist unless relieved by a soda-mint tablet until his evening meal. These attacks of pain, coming on three or four hours after meals, occurred somewhat periodically, persisting for three or four days to a week, and then would disappear without particular cause, and he would remain

free from discomfort for a few weeks to several months. Occasionally he would have some pain at 10 or 11 o'clock in the evening, but this was a comparatively rare occurrence. Likewise he would on rare occasions awaken at night with epigastric distress, at which time he would relieve himself by a swallow of water or a glass of milk. In addition to the pain he has suffered at times, when the attacks of discomfort were more severe, with *vomiting*, the vomitus consisting of the food eaten a short time previously. He has never noticed in the vomitus food eaten twenty-four hours or more before nor has he ever vomited blood. At times the vomiting has relieved the pain.

In addition to the pain and vomiting he has complained at times of sour, acid eructations, of burning throat pain, and of burning, dull depressing pain in the upper abdomen, relieved by food, hot water, or soda-mint tablets. He thinks that his stool at times has been black, but that this has disappeared again in a few days. At the time of the black stools he has not noticed any untoward symptoms, such as weakness, fatigue, vertigo, etc. He has lost moderately in weight, about 15 pounds, during the five years of his illness.

His past history is essentially negative, with the exception that in 1914, two years ago, he suffered with swollen knees, at which time his physician diagnosed his condition as gout. He denies all venereal diseases.

Family History.—He was married while quite young. His wife is well and living. He has two boys, one eleven and the other nine years of age, both well. His wife has had no miscarriages. His father is living and well. His mother, he thinks, died of abdominal carcinoma. There are no chronic constitutional diseases in his family.

Habits.—He smokes cigarettes quite considerably recently. Formerly he smoked cigars and a pipe, but in moderation. He drinks beer occasionally, although practically none during the past year. He feels that alcoholic drinks make his stomach complaints worse, and during the exacerbations of his symptoms he never takes alcohol. He exercises moderately, but believes that exercise generally increases the abdominal pain.

To sum up, then, as far as the history goes, we have here a young man, thirty-six years of age, a tea taster for twenty years, suffering from a *chronic, recurring* disease for *five years*, consisting essentially of epigastric *pain* or distress coming on three or four hours after meals, *vomiting*, *loss of weight*, and *black stools*. All of you, I am sure, will agree that this is an extremely suggestive history of gastric or duodenal ulcer.

Let us see what his further findings reveal.

Physical examination shows a somewhat pale young man of fairly good nutrition. His skin is soft and moist and of good color. His pulse is slow and regular, averaging 56 to 64 beats per minute, a moderate bradycardia.

His eyes are prominent; his pupils are equal and react well. His scleræ and conjunctivæ are clear, but rather pale. His teeth are in good condition. His tongue is slightly coated. His tonsils are visible and somewhat ragged, but do not allow pus to be expressed upon pressure.

His neck is of normal size; all lobes of the thyroid being palpable, but not enlarged. There is no cervical adenopathy.

His chest is well developed and symmetric. Excursion is equal and good on both sides.

The lung and heart findings are negative. The left cardiac border measures 11 cm. from the midsternal line and the right border 4 cm. from the midsternal line. The heart tones are clear.

Abdomen.—You will note that the left costal arch is somewhat more prominent than the right. The greater curvature of the stomach on percussion reaches two fingers below the umbilicus; the lesser curvature extends two fingers below the xyphoid process, suggesting a slight gastropnoia. Neither the liver nor the spleen are palpable on deep inspiration or enlarged on percussion. There are no palpable masses. There are no unusual areas of tenderness. The genitalia are negative.

Extremities.—There is no edema of the ankles. All superficial and deep reflexes are brisk and possibly somewhat increased, but symmetric.

Rectal examination discloses two small hemorrhoids. The anal sphincter is tight and the prostate small.

His temperature is normal, although on several occasions in the afternoon it has risen to 99° , 99.2° , and 99.4° F.

Laboratory Findings.—Single and twenty-four-hour specimens of urine resulted in negative findings. Blood-pressure registers 110 systolic and 75 diastolic. The blood examination shows a hemoglobin of 80, 3,900,000 red cells, 7300 whites. Differential count of the latter is negative.

An Ewald test-breakfast showed 60 c.c., no free hydrochloric acid, total acidity of 6, and a positive Weber test for occult blood.

A motor-meal showed no retention after seven hours. A fractional meal, using a Rehfuß tube and test-meal consisting of 300 grams of tea with 15 grams of lactose, showed a free acidity varying from 4 to 10, and total acidity varying from 15 to 34, with no retention of sugar.

Several examinations of the stool resulted negatively for blood. One showed a slight trace by the Weber test.

The *x-ray examination* showed a slight hypersecretion on an empty stomach, definite evidence of pylorospasm, motility six hours, hyperperistalsis, and, of greatest interest, a Haudek "niche" or pocket on the lesser curvature as positive objective evidence of a chronic penetrating ulcer (Fig. 65). This pocket was constantly present on all examinations, made at different times under varying conditions.

We conclude, therefore, in view of the five-year history of chronic "indigestion," in view of the trace of blood in the stomach content and stool, in view of the slight loss of weight and anemia, and, in particular, in *view of the definite objective evidence of a pocket on the lesser curvature*, that we have to deal here with a chronic penetrating ulcer of the lesser curvature, and we have made this diagnosis and have given our opinion to the patient.

The patient, Mr. H., inquired whether he could be cured medically. The question and the possibility of a medical cure was discussed very fully and frankly with him, and the statement was made that it seemed extremely doubtful that a chronic ulcer of five years' duration, causing an amount of anatomic change easily demonstrable in the *x-ray*, could be permanently cured by

medical means, and that, although medical treatment might give temporary relief, in all probability a resection of the ulcer would ultimately have to be made. Mr. H. inquired whether there might be any remote danger in such medical treatment, saying that he very much preferred a medical cure, if possible,



Fig. 65.—Penetrating ulcer of the lesser curvature before treatment. Arrow indicates Haudek "niche" or pocket due to crater of ulcer filled with bismuth. Case of A. T. H.

inasmuch as several mutual friends suffering with a similar complaint had recently been operated with most disastrous results. He was told that if he understood thoroughly that medical treatment in his case was merely a *trial*, then such treatment might well be instituted as a preliminary measure, and there would be

no danger in waiting three to six weeks to determine what the result of such treatment might be.

Treatment was begun December 7, 1915. The details of this treatment I will discuss with you later. Sufficient to say he was put on a regulation ulcer management, and for the first week or ten days did not do any too well, complaining from time to time bitterly of pain, being awakened at night with epigastric distress and "heart burn," with sour eructations, and on one or two occasions with vomiting of sour material. For example, on the 13th of December, a week after treatment was instituted, he complained of severe pain at 6 o'clock in the evening, which increased in severity in spite of the feeding of alkalies until 11 o'clock P. M., at which time a tube was put down and 400 c.c. of a highly acid secretion removed.

On the 19th, again, at 2.40 A. M. he was awakened with a severe pain, at which time the passage of a tube removed 180 c.c. of contents, showing a free acidity of 30, a total acidity of 83.

On the 21st of December he vomited at 7 and 8 o'clock A. M. A stomach aspiration revealed 100 c.c. of material containing 35 free and 78 total acidity.

However, about the end of December he started to improve, complained very much less of discomfort, started to gain in weight, his appetite increased, and in every way he continued to make good progress.

On the 14th of January he was discharged from the hospital. At this time he was having a diet of milk and cream, soft cooked cereals, eggnog, mashed potatoes, cream soups, puréed vegetables, and a slice of toast with each meal.

He was seen at intervals of two weeks after discharge from the hospital, during which time his dietary was progressively increased, his alkali progressively diminished. During this time he continued to make good clinical progress, as measured by gain in weight, freedom from symptoms, and general clinical improvement. He was a splendid patient, following directions accurately and faithfully. Three months after beginning of the treatment, namely, early in March, it occurred to us it might be interesting to see the condition of the lesser curvature, to see whether or not

the clinical improvement was a *functional* improvement only, or whether parallel x-ray findings indicative of anatomic or pathologic change could be detected. The reasons for the repetition of the x-ray and fluoroscopic examinations were again very fully discussed with the patient, and with his full co-operation he was



Fig. 66.—Healing of lesser curvature ulcer three months after institution of medical treatment. Arrow points to slight convexity at site of original ulcer. Compare with Figs. 65 and 67. Case of A. T. H.

again examined on the 3d of March, three months after treatment had been begun. The results of this examination were as remarkable to us as they were gratifying to the patient.

Fluoroscopically, the stomach appeared entirely normal, with normal peristalsis (in contrast to the previous hyperperistalsis), with no evidence of pylorospasm, and with a motility of

approximately *five hours*, a gain of *one hour* over the original examination. However, most interesting was the fact that *absolutely no sign of irregularity or pocket could be made out along the silhouette of the lesser curvature*. Not being able to believe our eyes, we repeated this examination twice within the succeeding ten days, taking pictures in all possible directions, but without

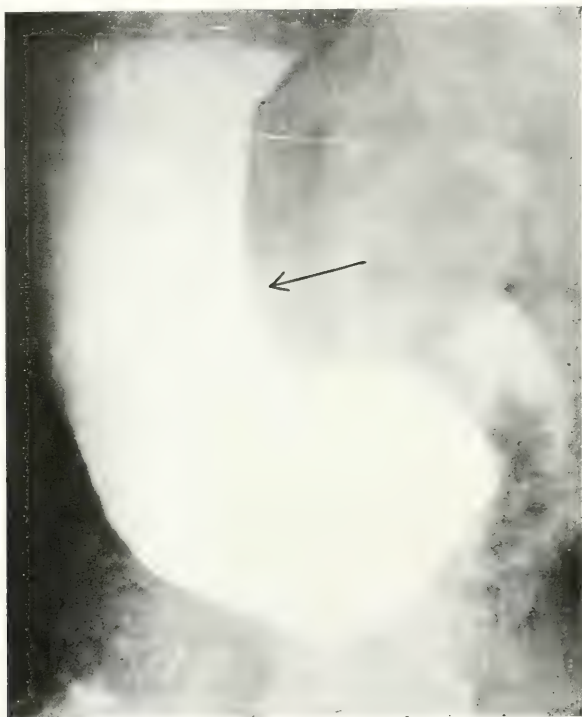


Fig. 67.—Healing of lesser curvature ulcer four months after institution of medical treatment. Arrow points to site of original ulcer. Compare with Figs. 65 and 66. Case of A. T. H.

finding any evidence whatsoever of a lesser curvature defect (Fig. 66). Although no definite pocket could be detected, a very slight irregularity of the nature of a slight convexity at the site where the original ulcer had been could be made out, as may be seen in the figure. Four weeks later another x-ray examination showed the lesser curvature to be entirely regular, even this slight evidence of irregularity having disappeared (Fig. 67).

To confirm these findings the whole examination was repeated three months later, in June, with practically identical findings. Late in June Mr. H. was again seen, complaining of renewed discomfort, and we were fearful of a recurrence, but after careful analysis of symptoms and examination of the stool it was found that he was suffering with a slight subacute colitis, which was promptly remedied on attention to his diet.

In retrospect, then, this case demonstrates a chronic gastric ulcer of the lesser curvature, definitely proved by *x-ray* and fluoroscopic examinations, which, under carefully controlled medical management, has healed within six months, and this healing, as far as can be judged, has progressed without scar or deformity or interference with gastric function.

It is of particular interest because at the outset it seemed most unlikely that a penetrating ulcer of such extent could be completely healed by medical means, and while this patient is still under some restrictions as to diet and will probably remain so for another six months, we have every reason to believe that should he have a recurrence of symptoms they will probably indicate a fresh ulcer rather than an exacerbation of the old one. The particular point that we wish to emphasize in presenting this case is to call attention to the advantages of *repeated x-ray examinations as a control of treatment*. For instance, it is well known that the disappearance of ulcer symptoms in ulcer patients is in no way indicative of *cure*, for in the same way that pernicious anemia patients improve and relapse as a part of the disease picture, so ulcer patients periodically have exacerbations of their symptoms without apparent cause, these exacerbations, as is well known, being perhaps seasonal or periodic, recurring and disappearing often without cause, so that the mere *disappearance* of a *patient's symptoms* with or without treatment is not positive evidence of *cure*.

In what way then *may* an ulcer patient be said to be *cured* of his ulcer? Of course at the outset this question goes back to the diagnosis. Did he *have* an ulcer? The so-called "ulcer history" or ulcer complaints of which so much is made by many surgeons and some internists as the most dependable feature of

the diagnosis is, of course, quite erroneous. If one treats patients for the "ulcer history" alone, of course one will have many "cures" and few failures, because probably a vast majority of these "ulcer patients" never had an ulcer at all. Many of them, of course, will *not* be cured, but will, in the course of time, show their real disease to be a cardiorenal trouble, pulmonary tuberculosis, gastropotosis, colitis, renal stone, etc., but if a positive diagnosis has actually been made and the ulcer actually demonstrated, what then are the positive evidences of *cure* under any form of treatment, medical or surgical?

The evidences of cure of chronic ulcer may be grouped as follows:

(1) The disappearance or remission of the patient's *subjective* complaints.

(2) The improvement in the *objective* appearance of the patient as gaged by his gain in weight, gain in hemoglobin, and in general well-being.

(3) The improvement in the test-meal findings, diminution in the acidity, and the improvement in the motility as gaged by test-meals.

(4) The disappearance of the occult blood in the stomach contents and stool, a point recently again emphasized by Boas.

(5) The change in the x-ray and fluoroscopic findings, *i. e.*, the actual disappearance of the ulcer, as in this case, or the changes in scar formation or in the stomach contour or in the type of peristalsis, pylorospasm, hour-glass contraction, and emptying time of the stomach as observed under the screen.

This last point, discussed under heading 5, is the point we wish especially to emphasize. Since this first case has been examined and controlled by this means, we have instituted this method as a routine in the clinic. We feel that in the case of Mr. H. the control by x-ray and fluoroscopic findings was by far the most valuable objective evidence that we had outside, of course, of the patient's general improvement. We feel justified in suggesting here that this method of control be used generally in the medical treatment of ulcer, and that if it is so used it will afford not only a valuable means of determining the healing of

chronic ulcer, but in a negative way will be equally valuable in determining which cases *will* heal and which *will not* heal and which will need surgical intervention. Likewise, it should be of value not only in a practical clinical way, but also in giving valuable information as to the healing process generally. By this means we should gain definite insight into the anatomy and



Fig. 68.—Lesser curvature ulcer before medical treatment. Case of R. W.

pathology of the healing process of chronic gastric and duodenal ulcer.

We have already obtained some interesting findings. A case very similar to the one just discussed occurring in the practice of Dr. J. C. Friedman, to whom I am indebted for the privilege of making prints of the x-ray slides, shows practically the same

findings. Figure 68 shows a lesser curvature ulcer before medical treatment, showing an even more pronounced pocket on the lesser curvature. This patient had only a very simple medical management, consisting of restriction of coarse foods, frequent feedings, and small amounts of alkali between feedings, never-



Fig. 69.—Lesser curvature ulcer three weeks after medical treatment. Compare with Fig. 68. Case of R. W.

theless showing a marked clinical improvement, together with an interesting change in the contour of the pocket on the lesser curvature (Fig. 69).

In contrast with these two cases of lesser curvature ulcer successfully treated medically I may be permitted to present very briefly the following case of chronic ulcer of the lesser cur-

vature treated surgically: This patient, a County inmate, for economic reasons refused medical care and preferred surgical



Fig. 70.—Lesser curvature ulcer before excision. See Fig. 71. Case of P. O.

excision (Fig. 70). At operation a large deep callous ulcer of the lesser curvature was found and removed (Fig. 71). While it is

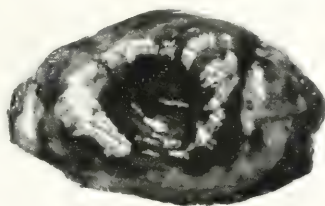


Fig. 71.—Lesser curvature ulcer excised at operation. Compare with x-ray, Fig. 70. Case of P. O.

impossible to state, of course, that this patient, the same as the other two patients, would have received as complete a cure med-

ically, such probably would have been the case. One wonders at the enormous potential processes of repair inherent in the stomach when a defect as deep and as callous as ulcers of this type, so easily demonstrated by the x-ray, may be completely healed by medical means. From our experience with these cases it is our firm conviction that all cases of this type should be given the benefit (if economic reasons do not interfere) of prolonged thorough medical treatment, with the expectation that the majority of them will be entirely and completely cured. In the event that the x-ray after such treatment reveals them still unhealed they can then be excised.

The following case is of a little different type: J. S. W., a merchant, twenty-eight years of age, came into the hospital November 10, 1914, in collapse, with a history of previous vomiting of blood and tarry stools and without previous history of abdominal distress. Examination showed an exsanguinated young man. No gastric analyses were made because of the hemorrhage. Under treatment the hemorrhage promptly ceased. A month after the hemorrhage (December 8, 1914) fluoroscopic examination showed deep active peristalsis of the stomach, motility five hours. There was no gross irregularity of the stomach or duodenal bulb, but the duodenal cap appeared small and could not be well seen in any position. He suffered with a second hemorrhage fourteen months later (January 6, 1916). A second radiographic examination made April 3, 1916, seventeen months after the first and three months after the second hemorrhage, showed a slow peristalsis, with defective bulbus and a considerable seven-hour retention. It was believed that the retention might be due to functional spasm, and he therefore was put under physiologic doses of atropin, starting him on 10 minims of the tincture of belladonna three times a day and increasing 3 drops daily until the physiologic effect was obtained, as noted by the dry mouth and blurring of vision. Three weeks later, April 24th, while under the physiologic effect of atropin he was again fluoroscoped, at which time the bulbus was still defective, but *the motility was reduced to five and one-hours*, a gain of over one and one-half hours.

The points of interest in this case are the following:

- (1) The ushering in of the disease with the profuse initial hemorrhage, absolutely without previous symptoms.
- (2) One month after the hemorrhage showing *small bulbus without irregularity; motility five hours*.
- (3) Seventeen months after the first hemorrhage *bulbus notably defective, motility seven hours; under atropin bulbus still defective, motility five and one-half hours*.

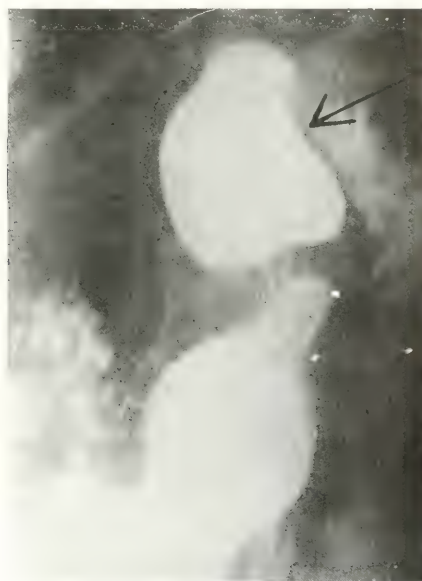


Fig. 72.—Normal duodenal cap.

In other words, the scar formation in the duodenal cap was interpreted as evidence of the healing of the ulcer, the bulbus deformity resulting from the scar appearing within eighteen months after the probable inception of the ulcer and resulting in very slight motor insufficiency.

It seems fair to assume that part of the motor insufficiency was due to the scar, but that the greater part was due to functional spasm either in the pylorus or duodenum. But of greatest interest in this case, and the point which again emphasizes the value of this examination, is that *one month* after the initial hemor-

rhage, presumably the beginning of the formation of an acute ulcer, there was *no deformity of the bulb*; eighteen months of healing, marked scar deformity, and contracture.

Before discussing further the deformity of the duodenal cap due to the healing of chronic duodenal ulcer, I may be permitted to show you a few examples of the normal duodenal cap (Figs. 72, 73, 74). These figures were taken at random from three normal individuals showing the typical duodenal bulb normally filled with bismuth. These figures will serve as control

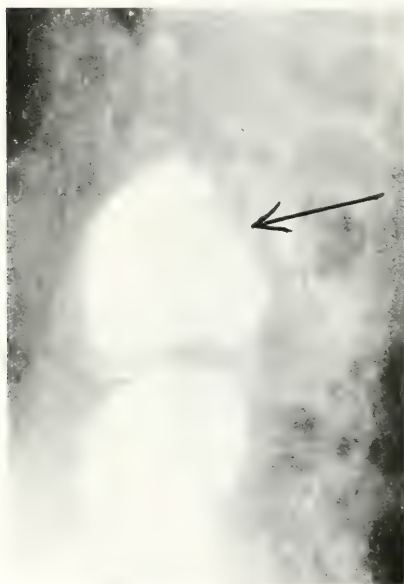


Fig. 73.—Normal duodenal cap.

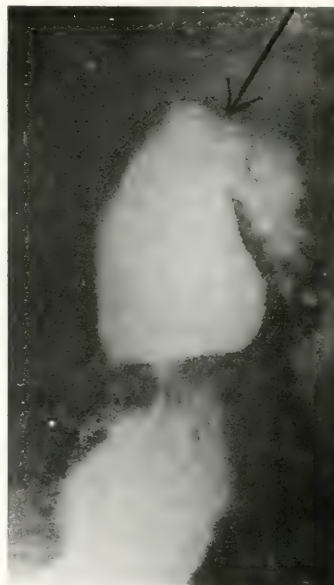


Fig. 74.—Normal duodenal cap.

figures to contrast with the deformities due to the presence of the chronic duodenal ulcer.

E. F. W., a man, thirty-three years of age, complains seasonally and periodically for twelve years of "indigestion" immediately after eating, distress at night, belching, black stools, vomiting of blood, and loss of weight.

Test-meals showed hyperacidity and hypersecretion, but with normal motility.

α -Ray, November 23, 1916, showed marked deformity of the

duodenal bulb (Fig. 75). Motility was less than six hours, peristalsis active, but within normal limits. Medical management resulted in a clinical "cure." Four and one-half months after the inception of treatment radiographic examination showed normal peristalsis, no pylorospasm, bulbus still defective, motility six hours (Fig. 76).

This case is of interest in showing that in spite of marked deformity of the duodenal cap both before and after medical



Fig. 75.—Defective duodenal cap due to chronic duodenal ulcer of twelve years' standing (E. F. W.) before medical treatment.



Fig. 76.—E. F. W. four and one-half months after medical treatment. Bulbus still defective, but not quite so contracted. Compare with Fig. 75.

treatment in a patient suffering for twelve years, probably having an ulcer for twelve years, there is no interference with the gastric emptying power, both motor meals and bismuth meals leaving the stomach in normal time.

One concludes, therefore, that marked deformity may occur with or without interference with motility, and that the one may have no causal relation with the other.

I. E. S., an attorney, thirty-one years of age, referred by his brother, a surgeon, complained for eighteen years of fulness, belching, and gnawing sensation late after meals. Test-meals showed hyperacidity, hypersecretion, and delayed motility. Several x-ray examinations in February, 1916, showed slow peristalsis, markedly defective bulbus, and considerable retention in six hours (Fig. 77).

One month after the institution of medical treatment, during which time his clinical progress continued satisfactorily, he

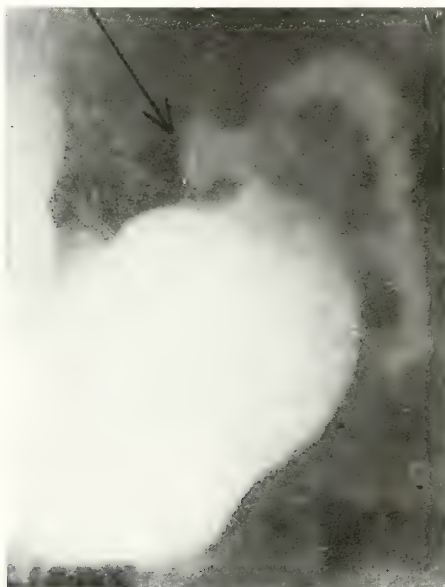


Fig. 77.—I. E. S. before medical treatment. Duodenal ulcer of eighteen years' standing.

showed normal peristalsis, bulbus defective, but *motility reduced to four hours* (Fig. 78).

This case, in contrast to the previous ones, while showing no change in the stomach morphology, showed a marked improvement in the gastric emptying time coincident with the general clinical improvement.

Studies such as these are now progressing in a considerable number of cases, and we hope that after following these cases

for a sufficient length of time that we can conclude accurately the chances of cure and the ultimate outlook in such cases, and particularly can decide as to which cases will remain well under medical management and which cases must ultimately submit to surgical interference.

At the present time the only conclusions that can be drawn are these:

(1) The ulcers of the *longest standing* in point of clinical symptoms show the most marked *deformity*, the deformity obviously



Fig. 78.—I. E. S. one month after medical treatment.

being due to scar formation, the tendency of ulcer scars being to contracture and to defective gastric and duodenal morphology.

(2) This marked deformity and contracture is actual evidence of connective-tissue contraction and scar formation and healing, and is in *no way of itself evidence of a surgical ulcer or of an unhealed ulcer*.

(3) The *deformity* caused by the scar is in no way *synonymous* with *obstruction* or *delayed motility*. As a matter of fact, the cases showing *greatest deformity* evidence the *greatest improvement*

under medical management, the motility being reduced from two to three hours. The cases showing the least deformity often heal with evidence of obstruction. These latter cases, providing the obstruction to the emptying time is pronounced and constant and unrelieved by atropin, are in all probability the cases which ultimately will demand surgical relief.

The advantages of this method of observation may be discussed as follows:

(1) It will give objective evidence of the mechanism of healing, of the extent of deformity, and of the nature of the healing process.

(2) It will give positive indication for or against surgical interference.

(3) It will aid in determining whether in a given case the recurrence of symptoms is due to an exacerbation of an unhealed ulcer or the formation of a new one.

(4) It will give evidence for or against surgical treatment and will aid in the selection of proper cases for either method.

(5) It will, in the long run, and in a large enough series of cases give information for the better selection and individualization of cases, so that one may determine more readily at the outset which cases are medical and which are surgical.

Etiology of Ulcer.—Before taking up in detail the actual medical management of these cases I should like to discuss a few points as to the etiology and symptomatology of ulcer as they relate to the medical management of these cases. A logical treatment of any disease presupposes accurate knowledge of its cause. From this standpoint we are very much at sea as far as ulcer is concerned. While a perfectly stupendous amount of work has been done on the experimental production of ulcer by countless investigators, very few actual practical clinical results have been obtained. While the infectious theory is alluring and popular, one hesitates to believe that removing the foci of infection in teeth, tonsils, gall-bladder, appendix, prostate, and elsewhere will of itself effectually cure chronic ulcer of the stomach. For, while these organs may serve as a source of infection and may serve as the genesis of a process which later will become

chronic ulcer, they probably are not the factors responsible for the *chronicity* of ulcer. We believe that of far more importance is the factor of *mechanically delayed emptying time*. We have shown experimentally in dogs¹ that chronic ulcer may arise from acute ulcers if certain factors are present—namely, prolonged and probably violent action of active gastric juice, that is, hypersecretion and hyperperistalsis—and that such ulcers may remain unhealed even if the acidity later drops to normal. (A case of this type is that of A. T. H., the first case reported, an ulcer of four years' standing, with subacid findings: free HCl 0, total acid 6.)



Fig. 79.—Experimental chronic ulcer of the dog's stomach. Five weeks' duration.

From these experiments it was found that the ulcers which evidenced greatest chronicity occurred in stomachs in which the motility was most impaired and hyperacidity most pronounced. The mechanism of the effect of partial pyloric obstruction in ulcer probably lies in the fact that retained food-stuffs act as continual mechanical irritants to the raw surface of the ulcer. We believe that we have produced experimentally in dogs chronic ulcer of the stomach in a way strikingly similar to the clinical syndrome in man. While it is dangerous to draw parallels from artificial

¹Experimental chronic gastric ulcer. Second Contribution to the Experimental Pathology of the Stomach, J. C. Friedman, M. D., and W. W. Hamburger, M. D., Chicago, Jour. Am. Med. Assoc., Aug. 1, 1914, vol. lxiii, pp. 380-384.

conditions in animals to clinical disease, in this instance certain conclusions seem justified. Pathologically, the similarity between these experimental ulcers and clinical ulcer is striking, as may be noted from Fig. 79, which is a photograph of a chronic ulcer experimentally produced in a dog's stomach of five weeks' duration.

The importance of this experimental work from the standpoint of treatment seems to me to be this:

If delayed motility, as produced by partial obstruction of the pylorus, is responsible for chronicity in ulcer, and the pyloric obstruction with resulting motor insufficiency and continuous secretion are the most important factors in chronic experimental ulcer, it is more than likely that primary partial pyloric stenosis from whatever causes, with secondary motor insufficiency and continuous secretion, are largely responsible for the delayed healing and chronicity of chronic ulcer in man. *Therefore in the successful treatment of chronic ulcer in man the relief of this motor insufficiency would seem to be of paramount importance*, and in actual practice such has proved to be the case, for it appears that in cases with *normal* or increased emptying time the chances for cure are immeasurably *better* than the cases with *delayed* emptying time. Therefore the point of attack in the medical treatment of ulcer is very largely the relief of motor insufficiency, pyloric obstruction from whatever cause, and improvement in the emptying time of the stomach.

As you will see, this factor is constantly kept in mind in the actual medical management of our cases. The control of emptying time is obtained by the use of foods and methods of feeding which will enable the stomach to most rapidly empty itself, and by the use of drugs, such as atropin and papaverin, which tend to improve the emptying time by releasing or relaxing whatever there may be of retention due to pylorospasm or spasm elsewhere in the stomach or duodenum.

Conversely, in those cases, as has been said, where the emptying time is persistently and continually delayed and unrelieved by medical management directed toward its relief, these cases, I say, are cases which in all probability will not do well per-

manently under medical management and will need mechanical surgical relief.

Symptomatology.—Of what importance is the symptomatology of ulcer as related to its *treatment*? In the symptomatology of ulcer probably the most important complaint is *epigastric distress*. This epigastric distress may vary all the way from the slightest abdominal "discomfort" after or before meals or after or before one special meal—all the way through "fulness," "pressure," "weight," "indigestion," "burning sensation," "gnawing sensation," "pain," severe deep "cutting pain" or deep "penetrating pain," "hunger-pain," "gnawing excruciating pain" at varying intervals after meals. Of course many ulcers are latent, as evidenced in the case of J. S. W., cited before, but, as far as chronic ulcer is concerned, the *majority* of them surely, if the history is closely analyzed, complain of some "indigestion," distress, or pain.

Therefore the mechanism of the production of this distress or pain is of tremendous importance in this way: If the patient comes to you because of epigastric *distress*, and you diagnose that the *distress* is due to *ulcer*, then when you put him under management and the *distress disappears* you say the *ulcer* has disappeared, but, of course, it has not or may not have disappeared. Why? In other words, you have been *treating* the *subjective complaint* of the patient and not necessarily the disease itself, and if you measure your results of treatment by the disappearance of symptoms you are bound to have many brilliant successes—but even more dismal failures! for, as you know, the disappearance of symptoms does not necessarily mean the cure of the ulcer. What does the disappearance of the symptoms mean? Before this can be answered one must know what the *appearance* of the symptoms means; in other words, the mechanism or cause of the symptom, epigastric distress. It has been the teaching for forty years, since the time of Cruveilhier, that the *pain of ulcer* is due to the *corrosive action of free hydrochloric acid*, and with the neutralization of free acid pain disappears. Within the past decade considerable doubt has been thrown by many observers upon the validity of this explanation. In fact, the

trend of modern thought on this subject has suggested an entirely different explanation. The explanation of the mechanism of the production of pain in gastric ulcer has been shown by a variety of ways to be due in all probability to *increased tension on the walls of the stomach from increased intragastric pressure*. Hertz, Barclay, Bolton, Cramer, and others subscribe to this interpretation of the pain.¹ In our clinic during the past three years we likewise have gradually come to the belief that the pain in ulcer is not due to the presence of free acid irritating the raw spot, but is due to increased gastric muscle tone. The experimental evidence for this belief has been recently published.²

This explanation of the pain mechanism may be readily demonstrated in a variety of ways, the most accurate possibly being the following: If one introduces a permanent tube into the stomach of the nature of a Rehfuß tube, and aspirates at regular intervals after the introduction of neutralizing alkalis or foods, one may quickly convince himself that there is very little, if any, relationship between the acidity and pain, *for the pain comes and goes without parallel changes in the gastric contents*. For instance, pain is frequently present with *total absence of free acid* and low or absent combined acid. Likewise, pain is frequently present in the absence of both free and total acid; that is, in a *complete* or *partial*

¹ Most recently A. J. Carlson. In his new book, "The Control of Hunger in Health and Disease" (University of Chicago Press, 1916), he discusses the "hunger-pain" of gastric and duodenal ulcer as follows (pp. 263, 264): "In normal persons the hunger sensation if sufficiently strong is painful. The patients with ulcer or hypersecretion describe these hunger-pains in part as continuous or persistent, in part as variable or "gnawing," precisely like the normal pangs of hunger except they are more intense or painful. The gnawing or rhythmic character of the hunger-pains in ulcer cases appears to the author to show that they are due to contractions. If the acid stimulation of the ulcer gives rise to these hunger-pains in ulcer patients, they have a different origin from the normal hunger-pains, as the latter are caused by strong contractions of the stomach, especially of the fundic and cardiac regions."

² Contributions to the Physiology of the Stomach:

XXXIV. "A Note on the Movements of the Empty Stomach in Certain Pathologic States," A. B. Luckhardt and W. W. Hamburger, Jour. Amer. Med. Assoc., June 10, 1916, vol. lxvi, pp. 1831-1833.

XXXV. "The Newer Interpretation of the Gastric Pain in Chronic Ulcer," H. Ginsburg, I. Tumpausky, and W. W. Hamburger, Jour. Amer. Med. Assoc., September 30, 1916, vol. lxvii, pp. 990-994.

achylia. As a matter of fact, in certain cases it is extremely difficult to neutralize all the free acid present by the administered alkali, as shown by the presence of free acid in the aspirated material, notwithstanding that the pain may be entirely relieved. Likewise, as Hertz has shown in six operatively proved ulcers, 4 ounces of $\frac{1}{2}$ per cent. of hydrochloric acid introduced through a tube into the empty stomach produced no sensation whatever. We have on several occasions confirmed these observations of Hertz, and likewise, in several cases of achylia with typical ulcer

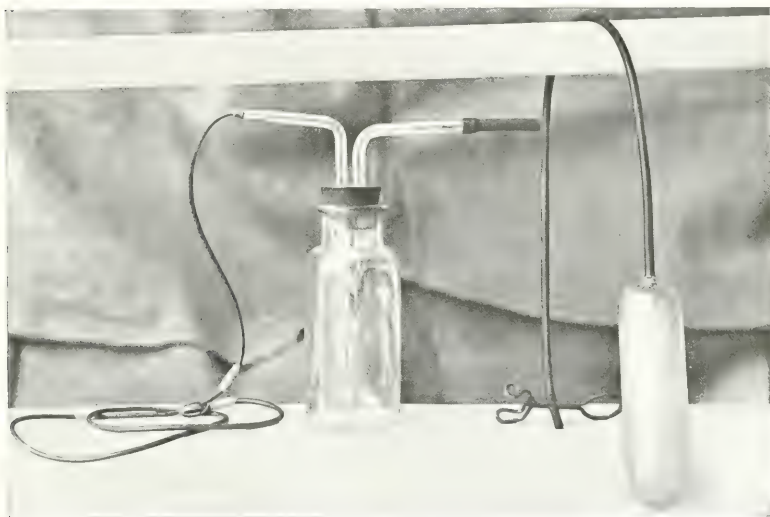


Fig. 80.—Inflated balloon and aspirating bottle with Rehfuß tube, for obtaining chymograph tracings and stomach contents respectively.

pain, we have shown that the administration of hydrochloric acid gives prompt relief from these pains. What, therefore, is the relationship between chemical reaction of the stomach and pain? It is apparent that there must be some direct relationship, for although free hydrochloric acid, at least in most instances, does not cause pain, the administration of alkali frequently gives relief.

We believe with Hertz and with Barclay, Cramer, and Bolton that there is in all probability another explanation for the pain, namely, that it is due to increased peristalsis and increased intragastric pressure. We have recently been interested in

proving up this conception by the introduction into the stomach of an inflated balloon (Fig. 80) attached to a chloroform manometer and a revolving smoked drum, thus obtaining chymographic readings of the stomach and noting the time at which the pain occurred on the tracings (Fig. 81). While these results are still few, they all tend to show that the *pain in ulcer patients is coincident with suddenly increased gastric muscle tonus, hyperperistalsis,*

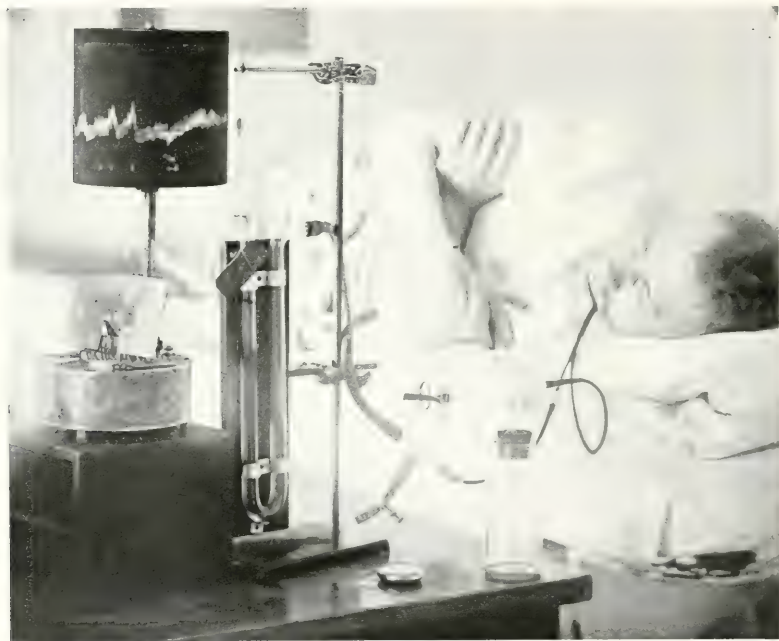


Fig. 81.—Method of obtaining simultaneous chymograph tracings and stomach contents from ulcer patients for analysis of patient's symptoms and interpretation of ulcer pain.

gastric muscle spasm, and increased intragastric tension, and is not dependent on irritation of the ulcer with acid gastric juice.

The tracings (Figs. 82-91, pages 445-449) will show some of these results.

These tracings were all taken from the same patient, the tube and balloon being introduced immediately after a full meal at 10.25 in the morning. The tracings in the series show a complete



Fig. 82.—Tracing No. 1. 10.25 to 10.43 A. M. Normal gastric peristalsis (digesting) *without* subjective discomfort. Tracing taken immediately after meal.



Fig. 83.—Tracing No. 2. 10.43 to 11.10 A. M. (S. D.) Normal digestive peristalsis *without* pain (one half hour after meal).

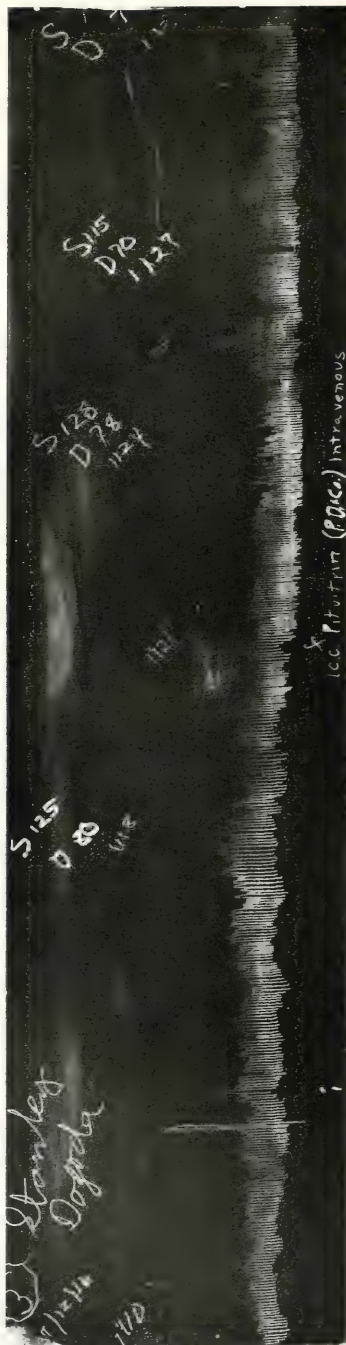


Fig. 84. Tracing No. 3. 11.10 to 11.34 A. M. (S. D.) Normal curve—no pain (three-quarters of an hour after meal).



Fig. 85.—Tracing No. 4. 11.34 A. M. to 12.16 P. M. (approximately one hour after meal). Idem.

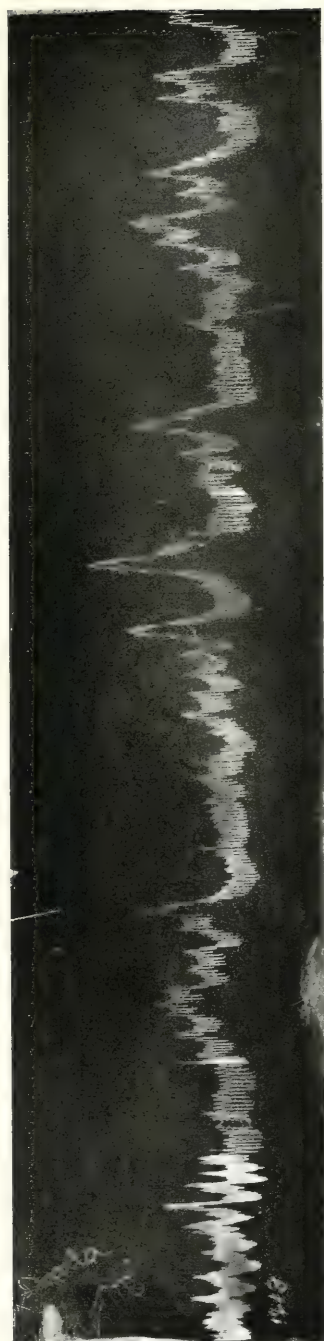


Fig. 86.—Tracing No. 5. 12.16 to 12.40 P. M. Increased gastric contractions associated with *slight* discomfort one hour and a half after eating.

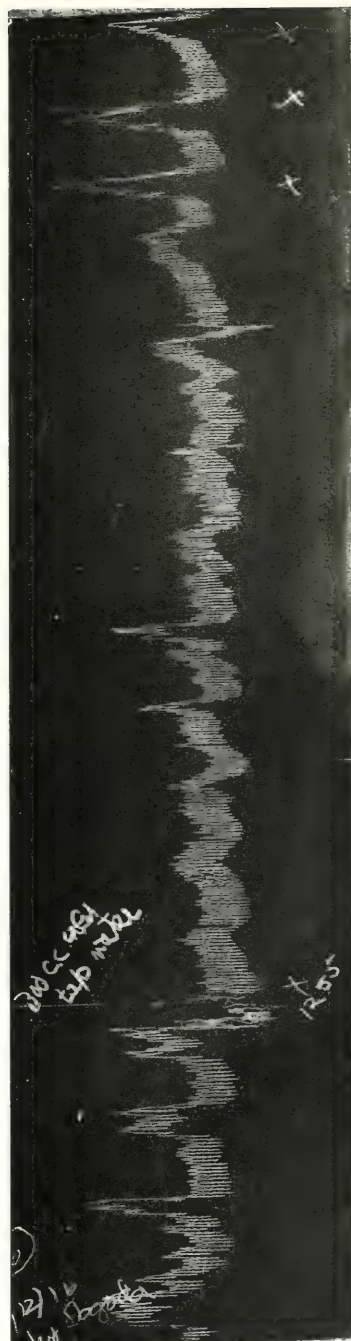


Fig. 87. Tracing No. 6. 12.40 to 1.00 P. M. (S. D.) More severe stomach contractions associated with *pain* two hours after meal (v).



Fig. 88.—Tracing No. 7. (S. D.) Period of quiescence—normal peristalsis following period of contractions with pain (an hour and three-quarters after meal).



Fig. 89.—Tracing No. 8. (S. D.) Beginning stomach contractions following period of quiescence.

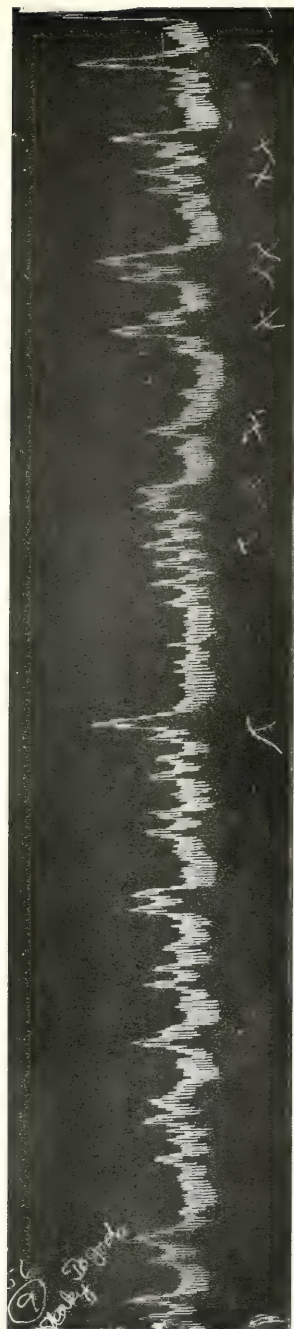


Fig. 90.—Tracing No. 9. Increased strength of contractions associated with abdominal pain (x).



Fig. 91.—Tracing No. 10. Vigorous, frequently repeated contractions; abdominal pain severe; practically constant. Greatest severity of pain synchronous with strongest contractions (x).

cycle of digestion from 10.25 in the morning until 2.50 in the afternoon. As will be noted in the first four tracings, the curve runs along practically at a uniform level until shortly after 12 o'clock noon, approximately one and a half hours after eating. An aspiration at 10.55 showed a free acidity of 20, total acidity of 90. During this one and a half hour period up until 12 o'clock noon the patient complained of no abdominal discomfort. Tracing No. 5 shows several changes in the curve due to suddenly increased intragastric tension. At several of these periods the patient complained of epigastric distress similar to the discomfort which brought him into the hospital. During the course of the succeeding tracings frequent complaints of discomfort and pain were complained of. The cross on the tracings indicates the times of most intense discomfort. The aspirations of the contents at this time showed free acidity varying from 58 to 80, total acidity from 78 to 128, but at no time was there any apparent relationship between the changes in the acidity and the subjective complaint of the pain. The most intense pain was felt toward the close of the observation, around 2.30 P. M., at which time the changes in the curve were most pronounced, although the acidities were somewhat lower. We feel that this series of tracings gives strong supporting evidence to the conception that pain in chronic ulcer is due to suddenly increased intragastric tension and increased muscle tone, and not to changes in the acid content of the stomach. Tracing No. 7 shows an interesting cessation of contractions following a period of increased activity, *the cessation of contractions being coincident with cessation of patient's discomfort, the presence of contractions coincident with subjective distress.*

In this work we have found that the gastric acidity remains constant or changes in a direction apparently in no way parallel to the patient's complaints. For instance, in more recent work, as yet unpublished, an ulcer patient at the Cook County Hospital complained constantly of pain associated with severe sudden rise in intragastric pressure, at one time with high acidity, at another time with absence of free acidity (total acid between 30 and 40), at another time no free acid and alkaline stomach contents.

However, if it is true that the pain in ulcer patients is not due to the acidity, but is due to sudden hyperperistalsis, why does alkali give relief?

We are at present engaged in experimental observations in answer to this question, and, as has been said, while our results are not complete, those that we have tend to show that the administration of alkali in certain concentrations *stops pain by stopping the gastric spasms responsible for it*. Cramer, six years ago, in his book on "Round Stomach Ulcer," suggested that the neutralizing of the stomach contents may relax the pyloric spasm and so increase the emptying time of the stomach. Recently some experimental work by Hawk gives further support to this view.

Therefore, in the medical treatment of ulcer if one relies on alkali, the same should be given not with the attempt of entirely neutralizing the stomach contents (and, therefore, in certain cases by giving of overwhelming amounts of alkali to a degree which will defeat one's own purpose; that is, by still further increasing these gastric spasms), but one should give merely an amount of alkali necessary to control these stomach contractions. Far better it would seem, therefore, to give, in addition to moderate doses of alkali, atropin or belladonna or other spasm-reducing drugs to control these pain-producing peristalses.

In addition to the control of motility and the control of pain-producing peristalses, one other fundamental conception in the treatment of ulcer may be discussed; that is, the value of bismuth. It is well recognized by radiographers and clinicians that many ulcer patients, as well as other gastro-intestinal patients, feel markedly improved after their diagnostic bismuth meals. From this experience, as well as from the generally well-recognized standpoint of the healing quality of bismuth, we have used in our clinic large doses of bismuth in the treatment of ulcer. Whether bismuth acts solely by coating over the raw surface of the ulcer and thereby acts as a vehicle for the growth of granulating cells, or whether there is some other action entirely unknown, we do not know. What our experience *has* shown is the empirical value of bismuth in the treatment of these chronic ulcer patients.

We have, then, three fundamental conceptions in mind in the treatment of ulcer, namely: the control of the emptying time of the stomach, the conception of the pain-producing peristalses, and of the value of the bismuth.

We may go directly to a discussion of the details of ulcer management.

Medical Treatment of Chronic Ulcer.—I. *Period of Observation and Differential Diagnosis.*—The patient upon entrance to the hospital is given a fractional test-meal, consisting of 15 grams of lactose in 300 grams of weak tea, and by means of the Rehfuß tube half-hourly aspirations are withdrawn and the material tested for free acid, total acidity, and sugar. The usual seven-hour motor meal is given the following day. On the third day of the examination the patient is fluoroscoped with the usual bismuth and buttermilk meal and x -ray plates are taken. I would emphasize the value and necessity of the personal observation of the clinician at the time of the fluoroscopic examination. Many times valuable points of practical aid in management are thus obtained. All the stools passed by the patient are sent to the laboratory and examined for occult blood, undigested food, and mucus. By means of these various examinations one should arrive at an accurate individual diagnosis, and it would seem almost unnecessary to emphasize the necessity of individualization in the diagnosis and treatment of gastric ulcer, for surely in few other diseases is the imperative necessity of such individualization more apparent. There surely is no such thing as a routine treatment of ulcer because of the variableness in the pathology and manifestations of this disease. One cannot treat ulcer patients *en masse* any more than one can treat them upon the history and complaints alone, no matter how carefully obtained and skilfully analyzed that history may be. Further, the necessity of an accurate differential diagnosis is equally apparent. In scarcely any other intra-abdominal condition is the differential diagnosis and the ruling out of non-ulcerative conditions more difficult and more important if one wishes to obtain successful results in the treatment. As is well known, the clinical complaints of ulcer patients are daily simulated in patients with

diseases of the pelvic organs; in patients with intra-abdominal adhesions; in Bright's disease with hypertension and abdominal crises of pain; in chronic gall-bladder and appendix patients; in diabetes with gastric crises; in carcinoma of the gall-bladder; in various other disease of the liver and stomach; in tabetic crises, to mention only a few of the differential diseases.

Further, one should not be content merely with a positive diagnosis of ulcer, but one is interested and anxious to learn whether that ulcer is acute, subacute, or chronic; whether it is thickened, indurated, and associated with perigastric or periduodenal adhesions; whether associated with cicatricial hour-glass stomach; whether there is an associated underlying disease, such as syphilis, tuberculosis, cancer, etc.; what the general condition of the patient is from the standpoint of severe secondary anemia, chronic blood-vessel disease, etc., etc.

It would lead us too far astray to mention some of the practical experiences in this regard, but it may not be out of place to mention very briefly the following: First, the patient in whom a diagnosis of chronic ulcer has been made, but in whom no attention was paid to the underlying chronic processes, failed to make satisfactory progress under the usual medical management until a positive Wassermann test had been obtained and the introduction of antisyphilitic treatment cleared up the picture. Another patient, who had been starved and treated by many excellent men for supposed ulcer, had in reality no ulcer at all, but a high-grade gastropptosis, and under forced feeding in bed, with the foot of the bed elevated, gained 60 pounds in two months and his "ulcer" was cured. A third patient, who *had* a chronic duodenal ulcer, had *in addition* a slight evening temperature and evidence of a thickened pleura on the left side. While he made considerable progress in the hospital under ulcer management, his ultimate recovery was obtained after a six months' sojourn in a nearby sanitarium for tuberculosis.

II. *Period of Absolute Rest in Bed and Starvation.*—While many patients probably do not absolutely need the withdrawal of all food by mouth, it has been my practice, where a positive diagnosis of chronic ulcer had been made, to put the patient ab-

solutely at rest in bed and withdraw all food and drink by mouth. The patient is given a daily cleansing soap-suds enema every morning at 7 o'clock. Thirty minutes later he is given a suppository consisting of $\frac{1}{2}$ grain powdered opium and $\frac{1}{4}$ grain of extract of belladonna. At 8 o'clock he is given a retention enema consisting of 8 ounces of tap-water. This retention enema is repeated at 12 o'clock noon, and at 4 and 8 o'clock P. M., so that during the day he receives four retention enemas of 8 ounces each. If the patient is unusually restless or nervous 10 to 20 grains of sodium bromid may be included in the tap-water enema. The retention enemas are given with a small soft-rubber catheter, inserted not more than 2 to 4 inches within the sphincter, and given slowly. It has been our experience that the enemas of plain tap-water do better than other nutritive enemas, and cause a minimum discomfort to the patient and do not entail greater loss of weight than any other method. In addition, a Priessnitz binder is usually applied in the morning and left on the entire day, and, if not uncomfortable to the patient, during the night as well. The time of fasting varies with the individual patient, all the way from forty-eight to ninety-six hours. If the patient stands the fast well, and does not become too restless and weak, it is usually prolonged to the fourth or fifth day. While many patients might do just as well without the preliminary starvation period, in our experience it does them no harm, and, as far as can be judged, is of considerable benefit in allaying pain, vomiting, nausea, and improving the general well-being of the patient. Many patients, as in the starvation treatment of diabetes, speak of a feeling of unusual well-being during the fasting period and say that the hunger is of minor importance. While this preliminary starvation period might well be cast aside, in patients with a bleeding ulcer we feel that it is absolutely necessary. The only difference in the treatment of such patients from the treatment just outlined is that an ice-bag or ice-coil is applied to the abdomen instead of the Priessnitz binder, and sufficient morphin and atropin is given hypodermically to insure complete rest of the gastro-intestinal tract. It is also our practice, both in the bleeding ulcers and in the simple chronic ulcers,

during the fasting period to insist as far as possible on complete mental quiet by the exclusion of all visitors from the sick room, for it would seem logical that an individual who is receiving no nutriment should conserve all strength and energy possible and should not dissipate same entertaining his friends and family.

III. *Period of Beginning Feeding.*—At 7 o'clock in the morning the patient is given an ounce of bismuth subcarbonate suspended in 3 or 4 ounces of moderately cool water. If the location of the ulcer is known, for instance, a pyloric or duodenal ulcer, the patient is requested to turn on his right side and remain in that position for from thirty to sixty minutes, thereby allowing the bismuth to come in most direct contact with the ulcerated area. From fluoroscopic examination this turning of the patient on his right side may be seen to be of actual practical service.

At 8 o'clock he is given $\frac{1}{2}$ ounce each of milk and cream, moderately cooled, with instructions to take same slowly, this $\frac{1}{2}$ ounce of milk and cream being repeated every hour from 8 A. M. to 10 P. M. At 8.30 A. M. he is given a powder of 10 grains each of sodium bicarbonate and sodium citrate, and this powder is repeated every hour from 8.30 to 10.30 P. M.

The following day, if the patient has experienced no distress from the first day's feeding, the diet is increased to 1 ounce each of milk and cream every hour from 8 A. M. to 10 P. M.

On the third day the feeding is increased to $1\frac{1}{2}$ ounces each of milk and cream.

On the fourth day, if everything has been progressing satisfactorily, feedings are changed to 2 ounces each of milk and cream every two hours from 8 A. M. to 10 P. M., the alkali likewise being changed to every two hours from 9 A. M. to 11 P. M.

On the fifth day a small portion, from 2 to 4 ounces, of thoroughly cooked and strained cereal is added to the 8 A. M. feeding and the 6 P. M. feeding. This cereal may be farina, cream of wheat, oatmeal, etc.

On the sixth day a soft-boiled egg is added to the noon feeding.

On the seventh day a soft-boiled egg is added to the 8 A. M. feeding and a cooked and strained cereal portion to the 12 o'clock noon feeding.

On the eighth day, if desired, the milk and cream feeding may be increased to $2\frac{1}{2}$ or 3 ounces each of milk and cream at two-hour feedings, and a small piece of thoroughly toasted bread added to the 8, 12, and 6 o'clock feedings.

On the ninth day a soft-boiled egg may be added to the 6 P. M. feeding, and gelatin, junket, custard, or tapioca to the noon meal.

On the tenth day, if everything has been progressing satisfactorily, a small portion of thoroughly cooked and ground meat (beef or chicken) may be added to the noon meal and a cooked and strained creamed vegetable purée may be substituted for the cereal portion.

From then on until the end of the second week the diet is kept approximately the same, although soft mashed potatoes, well-cooked rice, simple jellies, two or three slices of toast, and butter may be added.

During the third week the diet is gradually increased in amount, the amounts of milk and cream may be slightly reduced, and the feedings changed from two to three hourly periods. Minced chicken, minced ham, chopped squab, fish pudding, scrambled eggs, various soft puddings, cooked and strained fruits are added. Of the fruits, apple sauce, apricot purée, purée of prunes, cooked and strained rhubarb may be given.

From now until the end of the patient's stay in the hospital, which usually varies between four to six weeks, the diet remains approximately the same. The nutrient enemata are usually continued after feeding is begun for at least three or four days; at any event, until the patient is getting an adequate amount of nourishment. Water is then allowed in addition to the diet, but in rather small amounts, given frequently if desired. No one feeding should exceed 6 to 8 ounces during the first, second, or third week. The patient is usually kept constantly in bed for at least fourteen days from the beginning of treatment or longer. When sufficient nourishment has been introduced some time after the end of the second week the patient is allowed to sit up a half-hour in the morning and a half-hour in the afternoon in a large comfortable chair by the side of the bed. The length of time allowed up is increased daily to double the amount,

so that by the end of the third week or the beginning of the fourth week he is up from four to six or eight hours a day, although not walking. During the fourth week he is allowed to walk about his room or ward and gradually to increase his walking in the corridor or other parts of the hospital.

For the preparation of the meat, fowl, fish, vegetables, and fruit purées a fine meat cutter or grinder for the meats and a fine sieve or collender for the vegetables and fruits may be used. In recent times, however, both in the hospital and in the home we have been using the "Nixtamal" or combination mill, made by the Enterprise Manufacturing Company of Philadelphia, Pa., adopting this method from the Children's Department of the hospital. The "Nixtamal" mill may be obtained through any general hardware store, and is a splendid machine for thoroughly puréeing foods. It consists of two knives which grind the food-stuffs in a most thorough manner. Cooked spinach, corn, carrots, potato, prunes, apricots, apples all pass through this little mill and come out in a thoroughly pulverized form. It not only insures a thorough pulverization, but saves considerable time and energy to the housewife or diet kitchen.

The daily enemas are continued, although the retention enemas are stopped. If they are not sufficient and the stool becomes constipated, sodium phosphate in 10- to 15-grain doses or calcined magnesia in 10- to 15-grain doses may be substituted for the sodium citrate. If, on the other hand, there is a tendency to looseness of the bowels, bismuth subcarbonate or calcium carbonate may be substituted for the magnesia or the sodium citrate.

If there is evidence of considerable pain, particularly paroxysmal or periodic, colicky pain, $\frac{1}{100}$ grain atropin sulphate may be given twice daily, either by mouth or hypodermically, or extract of belladonna from $\frac{1}{4}$ - to $\frac{1}{8}$ -grain doses may be included once or twice daily with the alkali powders. The milk and cream may be mixed in bulk and placed in a small basin containing ice, and this given with the box of powder, and may be placed at the bedside of the patient with a measuring glass, so that the patient himself may direct his own feeding.

If there is recurring discomfort at any regular time during the day or night an aspirating tube may be introduced and the contents of the stomach withdrawn to ascertain the cause of the distress. However, if there is no distress, and the patient is doing clinically well, I see no reason for annoying the patient in such manner. Similarly, I do not see the necessity for actually maintaining complete neutralization of acid during the entire twenty-four-hour period, nor do I delude myself into believing that simply because pain has been relieved all free acid has been neutralized. As has been said earlier, the introduction of a tube at such times when the patient is free from discomfort, and the aspiration of material containing a fair amount of free acid, will quickly disprove any such notion which may have been entertained.

The plan outlined above, of course, is simply a general scheme, of which there are many modifications and variations to meet the particular case. If the patient is not doing well, frequent changes may be necessary, such as variations in the method of giving food, rate of increase of food-stuffs, withholding of certain combinations of food, etc. My own experience has been that the majority of patients tolerate the milk and cream mixtures the best, although frequently cream and Vichy water, one-third milk, cream and Vichy, milk and seltzer, cream and barley-water may be substituted. Likewise, certain patients frequently do better on a two-hourly feeding from the start instead of hourly feedings, and do better on a relatively dryer diet of toast, gelatin, and soft-boiled egg with a diminution in the liquid content of the feeding.

IV. *Discharge from the Hospital.*—Somewhere between the fourth and sixth week the patient is usually discharged. Before discharge, however, the patient is again fluoroscoped and x-ray plates taken and the findings compared with the original examination. The patient is instructed to follow his diet and report twice monthly for observation and checking up. During the first month out of the hospital no material change is made in the diet, provided the patient's progress is satisfactory. During the third month certain slight changes may be allowed, but only under careful observation and with the trying out of single

changes separately. For instance, bread, zwieback, or crackers may be substituted for toast. A small portion of tender well-cooked lamb, roast beef, steak, chicken, or fish may be allowed without preliminary grinding or scraping, likewise stewed apples, cherries, peaches, berries of all kinds may be substituted for the puréed fruits, as well as cooked asparagus tips, peas, tomatoes, etc., without straining or puréeing. Simple ice-cream, ices, cookies or cakes, cream soups, and tea may be added.

At the end of the third month the patient is again fluoroscoped, and if progress is satisfactory during the succeeding three months additions again are made to the diet, although strictly up to the end of the first six months no fresh fruits, no salads or fresh vegetables, no rich pastries or desserts, no condiments or spiced sauces are permitted. Up until the end of the third month the patient's allowance of bismuth, alkalis, and belladonna may be gradually reduced, although still continued. From the third to the sixth month these medicines are still further reduced, but should be partaken of from time to time. During this time likewise the patient is encouraged to exercise moderately, such as walking, golf, horseback riding if not too strenuous, swimming, tennis, baseball, etc. He is urged to restrict somewhat his working hours and to have ample time for relaxation and recuperation.

At the end of the sixth month, if there are no untoward symptoms, the patient is very gradually allowed to resume his old routine and habits, but very gradually and constantly under supervision and guidance, for just at this period should he throw caution to the wind he is liable to pay severely for it. During the second six months of the cure the patient still should be seen at least once a month, or once every six weeks, and allowed gradually to return to his former ways of living, so that at the end of a year he is practically back to his regular life, provided that life is lived in a hygienic way.

One frequently sees errors in the routine of individual patients which probably in some way are responsible or at least contributory to his disease. These naturally should be corrected. He should be urged to eat slowly, chew his food thoroughly, smoke moderately if at all, abstain entirely from alcoholic drinks, and

confine his activity within the limits of his own ability and not to approach fatigue.

After the completion of the first year the patient is urged to report at least once in six months for from three to five years, during which time it would seem highly advisable that he should be fluoroscoped once or twice during that time.

I believe it is only with such careful supervision and guidance that complete ultimate cure can be obtained. The necessity of observation for from three to five years I believe is particularly valuable from a prophylactic standpoint to prevent the formation of new ulcers.

It has been our experience that these patients usually gain in weight and, finally, within from three to nine months, state that their weight is more than it has ever been before. In fact, some of our patients have had to take obesity cures subsequently! However, the gain in weight is usually a favorable sign, and later may be easily controlled by cutting down somewhat the fat and carbohydrate content of the diet.

In conclusion, there are several points regarding the treatment of ulcer that are still under discussion, and about which men do not agree, and about which I should like to say just a few words:

First, the question of surgery. There has been much discussion recently regarding the medical versus the surgical treatment of ulcer. In a recent discussion at the meeting of the American Gastro-enterological Society in Washington, 85 to 90 per cent. of 2000 ulcers successfully treated *surgically* were contrasted with 85 to 90 per cent. of ulcers successfully treated *medically*. So that, apparently, in a large series of cases the results are equally good. The discussion has always reminded me of the words of L. Bamberger, who has well said that the comparison of percentage of cure by internal versus surgical treatment is "*unangebracht*" (ill-timed, ill-placed). "It is not a question to discriminate between either; it is really necessary to control both methods that one may complete the other; only then by such co-operation will there be further development both medically and surgically."

That the largest percentage of ulcers may be completely cured by internal management no one questions. To treat these patients surgically because a certain percentage of cases treated medically have not been cured is, again, "*unangebracht*."

His conclusions, after weighing all the evidence, were as follows: The treatment of chronic ulcer is a problem of internal medicine, cases not responding to repeated adequate treatment become operative cases. Surgery is particularly indicated in pyloric or duodenal ulcers with cicatricial stenosis and permanent delayed emptying time. After surgical treatment postoperative medical treatment for a year or longer is necessary.

Secondly, the necessity of complete neutralization of free acid. While this is theoretically possible, it is extremely difficult practically, and probably unnecessary. By the methods of frequent feeding with moderate doses of alkali between feedings, peptic digestion is, if not entirely controlled, materially reduced, surely sufficiently to allow the average ulcer to heal. The attempt to permanently neutralize all free acid becomes a double-edged sword; the giving of increasingly large amounts of alkalis, as has been repeatedly shown by Pawlow and others, acts as a gastric irritant for the production of more gastric juice, thereby initiating a vicious circle. A more remote danger occurs at times; namely, the production of a general edema and anasarca from the retention of chlorids similar to the edema and chlorid retention produced in diabetes from the exhibition of very large amounts of sodium bicarbonate. While the chlorid retention and edema very promptly diminishes with the withdrawal of alkalis, its occurrence often is most alarming and terrifying to the patient and an occurrence much to be regretted.

Third, the advisability of the passage of the stomach-tube and withdrawal of large amounts of continued secretion. As has been said earlier in the section under treatment, if there is severe discomfort, occurring regularly at some point in the twenty-four-hour cycle, it is often highly desirable, if not imperative, to pass a stomach-tube and withdraw the contents. If, however, progress is clinically satisfactory I believe it to be quite unnecessary to put down a tube for this purpose. Using a minimum amount

of alkalis, together with bismuth and physiologic doses of atropin, together with the bland fat diet, control the outpouring of gastric juices far better than its removal by mechanical means.

Fourth, the question of cicatricial stenosis. From fluoroscopic and radiographic studies of the healing process, as well as from experience gained by experimentally produced stenosis in dogs, I do not believe that delayed emptying time due to actual cicatrix formation is ever corrected medically. Surely the delay in the emptying time due to edema, inflammatory exudate, and spasm will be markedly improved under medical treatment, but those cases which, after having had the benefit of prolonged medical treatment, still show radiographically cicatrix formation and marked delayed emptying time, those cases, I believe, belong to the surgeon.

CLINIC OF DR. ISAAC A. ABT

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FOR CHILDREN)

INFANTILE PARALYSIS (ACUTE POLIOMYELITIS)

Historical. Epidemiology. Etiology. Peculiarities of the Virus of Poliomyelitis. Points of Entrance. Viability. Method of Spread in the Body. Symptomatology in Detail in the Different Stages of the Disease. Clinical Classification of Medin. Eight Types of Cases. Prognosis. Differential Diagnosis. Pathogenesis. Prophylaxis. Treatment in the Acute Stage. Proper Care of Paralyzed Muscles. Present Status of the Serum Treatment.

THE little girl whom I desire to present to you this morning is seven years old. She was perfectly well until the first part of June. About the middle of the month an indefinite cough developed, which about the 22d changed to a definite whoop. There was no doubt that she was suffering from pertussis. The cough, however, gradually grew less in intensity and the paroxysms diminished in number, so that after the middle of July she seemed to be recovering from the whooping-cough.

On July 27th she was taken ill suddenly with vomiting and a temperature of 103° F. The fever continued and the child remained in bed. After about a week, when she was ready to arise from bed, it was noticed that she was weak, that she stumbled a great deal when she endeavored to walk—indeed, it was impossible for her to walk or stand. The difficulty was more noticeable in the right leg, and the right arm was also affected. At this examination (August 10, 1916) she cannot raise the arm above her head. The upper arm is more affected than the forearm. During the first days of her illness she suf-

ferred great pain in the muscles of the affected limbs. She can sit up if assisted, but cannot raise herself from her bed. She has some difficulty in speech. She talks with a nasal quality; is extremely constipated; has no urinary symptoms, and no mental symptoms, though she is very irritable. She sleeps well, her appetite is normal. She has no pain in her head, nor does she complain of any dizziness.

The patient never had any illness before the whooping-cough except a mild attack of measles. She is the only child. The parents' health is good. She has not been exposed to any other children sick with acute paralytic disease and no history of infection is obtainable. Her temperature this morning is 98.4° F. She weighs about 40 pounds. The urinary examination is negative; the blood shows 75 per cent. hemoglobin, 17,000 leukocytes, of which 42 per cent. are lymphocytes, 6 per cent. large mononuclears, 49 per cent. neutrophils, and 3 per cent. transitional.

Upon further examination it is found that her eyes are freely movable. There is no paralysis, strabismus, or nystagmus. The face is symmetric, the tongue protrudes in the midline, the palatal action is slow, though not abolished. The muscles of the back are weak. The intercostals seem to lift very slightly in the act of respiration. Indeed, respiration seems, for the most part, diaphragmatic.

The right arm is distinctly weaker than the left. The deltoid group on the right side is definitely paralytic, whereas the muscles of the forearm seem to be, for the most part, intact. The tendon reflexes of the lower arm on the right side are present and the reflexes of the upper arm of the right side are diminished. The left arm is freely movable and under perfect control. The right leg shows marked paralysis, the peroneal group of muscles being most affected.

The knee-jerk on the right side is distinctly diminished, though not absolutely lost. The thigh muscles are flaccid. The abdominal reflex is present. Walking is difficult; indeed, she requires considerable assistance in order to walk across the room. She finds it almost impossible to control the right leg, and the muscles of the back and abdomen seem very definitely affected.

I present, then, for consideration a case of anterior poliomyelitis, of the spinal type of moderate severity, and I desire briefly to discuss with you this morning some of the points in connection with this disease.

HISTORICAL

Anterior poliomyelitis, particularly in its epidemic form, is a disease of recent origin. Infantile paralysis, as such, was known in the eighteenth century. While the disease has appeared sporadically for a long time, epidemics are of recent occurrence. The disease is infectious in nature, it is associated with a high mortality during the acute stage, and in those children who survive, severe atrophy and degenerative changes in the muscles and bones occur. The disease may be considered one of the most treacherous and most severe of the acute diseases of childhood.

Scientific investigation of the disease began about the middle of the last century. Jacob Von Heine first described it about 1840. He recognized the disease as a separate entity associated with paralysis and believed it peculiar to childhood.

Underwood in 1784 recognized the condition and thought it a dentitional paralysis. Heine in 1860, in a second publication, recorded the fact that the seat of the disease was in the spinal cord, and at that time suggested that the anterior gray cells were specifically involved. During the following years this conclusion was confirmed by more detailed anatomic study. Cornil in 1863 showed that there was a diminution in the size of the anterior lateral column and an atrophy of the anterior ganglion cells.

In 1870 Charcot and Joffroy showed definitely that the anterior gray cells were degenerative, and that the muscle groups supplied from these cells were atrophied. Further observation showed that the interstitial degeneration of the cord might be observed in fresh cases, and that the degeneration of the ganglion cells was a secondary process.

Strümpell in 1880 maintained that the disease was an acute infectious process and might occur in epidemic form. This observation, which at first was not received seriously by the pro-

fession, has been abundantly confirmed during the last thirty or thirty-five years.

In 1890 Medin had the opportunity to study groups of cases in small and in large epidemics, and he ascertained that the localization of the disease was not only spinal, but that it also might be cerebral, bulbar, and involve peripheral nerves. It was Wickmann, one of the early students of the epidemic form of the disease, who suggested that anterior poliomyelitis be known as the Heine-Medin disease. Wickmann contributed much to our knowledge of the symptomatology and pathology of the disease. He also called attention to the abortive form, and recognized the importance of contact infection.

The experimental study was begun by Landsteiner in 1908. He pointed out the possibility of contagion, the fact that brain and cord substances contained the actual virus, and also the possibility of conveying the disease from man to monkeys.

EPIDEMIOLOGY

Colmer was the first to describe the epidemic form of the disease in America. He reported 11 cases in West Feliciana, La., in the fall of 1841, where all the cases were under two years of age, and where all recovered. The first accurate description of an epidemic was reported by Medin in 1887. He observed 2 cases in May, 1 in June, and 2 in July. The disease increased in frequency in August, and from the 9th of August to the 23d of September there were 29 cases. Twice he saw children of the same family sicken with this disease in a few days.

Wickmann reported 1000 cases. The results of his observations may be briefly stated: The disease appears in the late summer and in the early fall, between July and November. It usually attacks children up to the fifth year, though adults may be affected. The incubation period is about eight days. It may be much shorter. It may be as brief as one day or as long as fourteen days. Wickmann does not think that the disease is an air-, food-, or water-borne disease. Children who have been exposed to infection do not sicken in any uniform number of days after contact with the disease. They seem to be successively attacked,

i. e., one may fall ill five days after exposure, another seven days, and a third child ten days after exposure. He says that the infection seems to be carried from case to case by contact, abortive cases are not uncommon, and he thinks that certain people are carriers, though they themselves may remain immune from the disease.

The first case that occurs in any region may usually be traced to a visit made by somebody from an infected district. Very often the disease occurs among several children in the same family. The disease is frequently spread through the school. School epidemics are not infrequent. Lines of travel—railroads, streets—seem to be the routes along which the disease spreads. It does not seem to depend upon density of population. Epidemics have not spared sparsely settled rural districts. The disease may, indeed frequently does, occur in sporadic form.

Wickmann does not believe that dogs, chickens, or other animals are susceptible to poliomyelitis, and he does not think that they spread it.

Müller describes an epidemic in Hessen. The disease lasted from August to December, with its acme in October. He saw typical and abortive cases. He reported that the disease spread along lines of communication. He noticed, too, that it did not first occur among the permanent population, that is, among the farmers' children, but rather among the fluctuating and traveling population. He observed that the children of hotel-keepers, coachmen, male servants, laboring people who go from town to village, letter carriers, telegraph repair men, and school-teachers were frequently attacked.

It would be almost impossible in one or in several clinical lectures to mention all of the outbreaks which have occurred in the United States, even in a relatively short period.

The disease first appeared in the eastern part of the United States in 1907. It is likely that it was brought from Europe, where it had been prevalent in the Scandinavian countries for about twenty years. In 1909 the disease made advances in the United States. At this time it extended into Canada. It has been assumed that the Scandinavians brought it from their

native shore to Minnesota. It traveled westward to Nebraska and even to the Pacific coast. At first the epidemics were small. In 1880 and 1890 10 cases constituted an epidemic. A little later 20 cases. In 1894 126 cases were reported in America. In 1905 the disease prevailed in the Scandinavian countries, coming to America in 1907, and almost constituting a pan-epidemic. *In thirty years the disease has appeared under our very eyes, has increased in force, virulence, and deadliness, and may be said now almost to encircle the world.* It has been suggested that new methods of communication or changes in the modes of living and distribution of mankind have brought the epidemic form of the disease into being.

It does not seem likely that a new predisposition for the disease has occurred. It seems more probable that the virulence has increased and its tendency to be carried has become greater. Certain it is that the mortality has become higher, that adults are more frequently attacked than formerly, as well as infants before the first year. The brain itself is more frequently involved than was noted among the sporadic cases, and the abortive cases seem to be increasing in number.

Early in the summer of 1907 there began an epidemic of poliomyelitis in and about New York City. There were probably 2000 cases, skirting Long Island Sound into Connecticut and up the Hudson. The disease began to show itself about May, 1907, the number of cases increased rapidly during June and July, and the epidemic reached its height in July and August. The mortality was about 6 or 7 per cent.

Small epidemics were reported in various sections following the New York outbreak. Thus, Terriberry reported 50 cases at Ridgeway, Pa., in the summer of 1907. Griffin reported 20 cases in Oceana County, Michigan, in the same summer. Free reported an epidemic at Dubois, Pa., in the same year. Over 100 cases occurred in the Alleghany Mountains. Hamilton reported three epidemics, all more or less extensive, in Minnesota in 1908. Lovett, in a report submitted to the State Board of Health of Massachusetts for the years 1907 to 1910, records numerous outbreaks throughout the state. Lovett also calls

attention to the fact that in 1909 140 cases occurred in Cuba. This was the first epidemic reported from the tropics. Apparently the disease did not exist in Cuba before 1907. He thinks that it was imported into Havana from New York. In 1909 Shidler reports a number of cases occurring in Nebraska. McClanahan in 1909 reports more fully the Nebraska epidemic. There were 1000 cases, with about 137 deaths. The first was reported in March and only 20 cases after November. It was a disease of the rural district. The Fourth of July celebration was held in Stromsberg, Polk County, and within two weeks after that the disease spread like a wave over the adjoining country.

Jacolyn Manning reports an epidemic of 352 cases which started in Eau Clair County, Wisconsin. In the State of Washington in 1910 397 cases were reported. In Missouri 309 cases were reported in 1910. In Iowa 604 cases occurred in January, 1911. There were 189 cases in Kansas in 1910 and 5 in Oklahoma. In 1911 Cleveland, Cincinnati, and Ohio experienced epidemics. There was also an epidemic at the same time in Covington, Ky.

The Epidemic of 1916.—At this time it is too early to record the history of the epidemic of 1916. The list of dead and crippled is not yet compiled, and the extent of the disease in area is not yet mapped out. We know that New York City has borne the brunt of the 1916 epidemic, though the disease has traveled south and west, occurring in mild epidemic and sporadic form over an immense territory.

In most of the cases in New York the paralysis made its appearance a few days after the onset of the disease. The longest period that elapsed between onset and paralysis was sixteen days. In between 5 and 8 per cent. of the cases more than one child in the same family was attacked.

ETIOLOGY

Since the time of Underwood one hundred years have elapsed without any definite knowledge as to the nature of the infection. It is true that Strümpell considered the disease as an acute infectious process of unknown origin. In later works we find a num-

ber of causes, vague and unfounded in nature, such as trauma, catching cold, hereditary disease, rickets, scrofulosis, and syphilis. Heine, who was the first to recognize the disease and who indicated the anatomic location, believed that it was due to a compression of the spinal cord by an inflammatory exudate.

Strümpell in 1884 attempted to show that poliomyelitis and polioencephalitis were the expression of an infectious disease, and undoubtedly due to a specific cause. He arrived at this conclusion on account of the acute onset with high fever, tendency to unconsciousness, headache, gastric disturbances, occasional splenic tumor, albuminuria, and swelling of joints. He compared this disease with the nervous phenomena associated with diphtheria, typhoid fever, and small-pox. He voiced the opinion that acute encephalitis and polyneuritis may be manifestations of the same specific process as poliomyelitis, differing only in the localization of the infectious process. In 1893 Dauber, Goldscheider, and Siemerling examined the cords of patients dying of poliomyelitis for micro-organisms, with negative results. Medin and his assistant, Riessler, sectioned the cord and stained for bacteria without result. In 1898 Buelow-Hansen found diplobacilli which stained according to the *Gram* method, though the investigators themselves were reticent as to the significance of the bacteria in the production of the disease.

Many organisms have been isolated—the diplococcus, pneumococcus, meningococcus, and staphylococcus—though no conclusions can be drawn from these findings.

Geirsvold injected a variety of organisms into the spinal canal of guinea-pigs. He used colon bacilli, streptococci, and staphylococci. The animals fell sick with spinal disease, which did not, however, partake of the nature of anterior poliomyelitis.

Landsteiner and Popper in 1909 examined a number of cases of spinal cord disease bacteriologically without any definite result. They injected spinal-cord substance into the peritoneal cavities of guinea-pigs, rabbits, mice, and monkeys. The first three animals remained well, though the monkeys were successfully inoculated with the disease. These animals became paralyzed in such a way that the effect resembled the Heine-Medin infec-

tion. The pathologic examination of the spinal cord showed microscopic and macroscopic changes similar to those occurring in a human being sick with poliomyelitis.

Later observations of Landsteiner and Prasek showed that the disease could be communicated by inoculation from one monkey to another. It was shown that the virus resembled somewhat that of rabies. It remained active in glycerin. It retained its virulence in the frozen state and it could be dried over potassium hydroxid. It has been ascertained that the salivary glands may contain the poison, that the virus is filterable, and these findings have been corroborated by many other investigators.

Flexner and Lewis in 1909 succeeded in inoculating a monkey through a trephine opening in the skull, using portions of a spinal cord obtained from a case of poliomyelitis six hours after death. Flexner and Lewis, in a later article in which they consider the nature of the virus of epidemic poliomyelitis, conclude that in view of the negative results of bacteriologic and histologic examination, the infecting agent belongs to the class of the minute and filterable viruses which thus far have not been demonstrated with certainty by the microscope.

Levaditi (1910) observed the constant presence of a great number of minute corpuscles stained deep red by Löffler's method. These were obtained following the incubation of an active Berkefeld filtrate bouillon for fifteen days. Monkeys inoculated by this incubated filtrate became paralyzed.

On microscopic examination, Römer and Joseph found in the filtrate of the emulsion of brain and spinal cord of a poliomyelitis monkey, small oval, weakly refractive immobile bodies.

Every known bacteriologic technic has been employed, though the results have been negative.

Peculiarities of the Virus of Poliomyelitis.—The active agent in the production of poliomyelitis, according to Landsteiner, Flexner, Levaditi, and Lewis, belongs to the class of filterable viruses. It passes through porcelain filters. It is true, however, that the filtrate is slightly less toxic than the unfiltered tissue. The virus remains active in 50 per cent. glycerin. It resists low temperatures. It may be kept in a refrigerator for

fifty-two days and still retain its virulence. It may be frozen and still remain virulent. On the other hand, warming the infective tissue to 45° C. diminishes its infectiousness. Warming to 50° C. for half an hour destroys the virulence. The virus of the disease resists drying. The spinal cord of a monkey dead of the disease remained infectious for twenty-eight days. Sterile milk and sterile water into which the affected cord was placed were virulent for thirty-one days.

The small oval bodies which were described by Levaditi have also been found by Römer and Joseph, Flexner and Noguchi. These bodies have been grown on human ascitic fluid agar with the addition of a piece of normal rabbit kidney. The growth consisted of colonies of these small oval bodies, sometimes double and sometimes in chains. By the injection of this culture material into the peritoneal cavities of monkeys poliomyelitis could be produced. It is thought that the bodies seen by Römer, Joseph, and Levaditi are the same as those described by Flexner and Noguchi.

The organism producing poliomyelitis develops under anaërobic conditions. Culture material made with the addition of human ascitic fluid inoculated with the active virus of the disease contains virulent substances which will produce poliomyelitis if injected into the cranial or peritoneal cavity of a monkey.

Points of Entrance.—Clinical experience points to the fact that the upper respiratory tract, the pharynx, mucous membrane of the nose, bronchial tubes, and in somewhat rarer instances the digestive tract are the points of entrance. Animal experiments strengthen this view.

The virus is found in the tissue substance of the central nervous system. It is not found in the cerebrospinal fluid, not even in fresh cases of the disease. It is not found in the blood, nor can it be inoculated into another animal by injecting the blood. On the other hand, it may be definitely stated from experiments that the virus is contained in the mesenteric glands, in the tonsils, and the pharynx. It is probably given off by the secretions of the mouth and throat. The virus is undoubtedly found in the secretions of the mouth, nose, and throat of those

who are sick and who have sustained paralyses, but also in the abortive cases. It occurs in the mucous membranes of those who have come into immediate contact with the sick.

The virus has been demonstrated in the gastro-intestinal tract of those who are sick with the disease. It is probable that this may have been swallowed from the mouth and throat.

Viability of the Virus in the Body.—The virus may remain active in the animal for a long time. It may retain its virulence on the mucous membrane of man or monkey for weeks, months, or even years. In this way the carriers of poliomyelitis may be compared with chronic typhoid carriers, who may remain infectious for a long time.

Method of Spread in the Body.—Wickmann originally thought that the active cause of poliomyelitis followed a perineural route in its journey to the central nervous system. The blood, as has already been pointed out, remains free of infecting material. The lymph-channels, particularly the perineural and perivascular structures, carry the disease-producing agent to its destination in the central nervous system.

SYMPTOMATOLOGY

A typical description of the course of the disease may be briefly summarized as follows:

In the midst of perfect health the patient falls suddenly ill with headache, fever, constipation or diarrhea, or vomiting. Occasionally pharyngitis or bronchitis, hyperesthesia of the entire body, and profuse perspiration occur. The fever lasts only a few days. During this febrile period or shortly thereafter flaccid paralyses occur. They may be in the upper or lower extremities or the musculature of the trunk may be involved. If the patient be examined early and carefully it is nearly always found that the paralyses have not occurred suddenly, but that they have come on gradually, manifested by more or less muscular weakness several days before the actual onset of the complete paralyses.

The tendon reflexes diminish and gradually disappear as the paralysis becomes marked. The fever tends to disappear or grow less. During the febrile stage the reflexes may be sharp

or exaggerated. Gradually there is a diminution in the paralysis, and in many cases where both arms and both legs were involved paralysis and weakness gradually disappear from upper or lower limbs and are ultimately confined to the extremities, which will remain more or less permanently affected. Eventually individual muscles or muscle groups will continue weak. After the occurrence of the disease one can determine pretty well which muscles will remain involved, and in those which are to remain paralytic the electric reactions diminish and the reaction of degeneration occurs early. The muscle groups which are to become permanently involved become atrophic.

For the purposes of description we may divide the disease into:

- (1) The incubation period.
- (2) The prodromal period.
- (3) The initial febrile period.
- (4) The stage of paralysis.
- (5) The period of repair.
- (6) The residual paralysis.

The Incubation Period.—The disease is undoubtedly due to a living virus. The duration of the incubation period may be very short. Wickmann says it may be one day. Kling and Levaditi place the period at two to three days. The average incubation period lasts about a week. It may be stated that it takes not less than five nor more than ten days. The infection of monkeys along the intracerebral or peritoneal route was from three and one-half to fifteen days, the average being nine and one-half days. Levaditi showed in his experiments on monkeys that the infection sometimes developed more rapidly if the virus was injected into the pharynx than into the central nervous system. Flexner and Lewis noted cases in which after the injection of a small quantity of virus the disease developed as late as thirty-three or forty-six days after the injection. This would suggest that in human beings the incubation period may be of considerable duration.

The *prodromal stage* and the *initial febrile period* merge into one another and may be considered together.

It is frequently stated that the paralysis occurs suddenly, though, as a rule, there are premonitory symptoms. These may be very short, lasting only a day, or, on the other hand, they may last a week. Fever is the most frequent symptom. There are only a few recorded cases in which it has been said to be absent. The fever may be short, lasting only a few hours. It need not necessarily be high. Chills are usually absent. The fever may be continuous or it may be remittent in character. The remissions may be complete and the patient may remain afebrile for a considerable time, so as to lead family and physician to believe that the patient has recovered. The pulse is rapid, indeed, more rapid than is warranted by the temperature. Sometimes tachycardia occurs. The cause of this may be an involvement of the bulbar centers, producing more or less vagus paralysis.

Symptoms on the part of the gastro-intestinal and respiratory tracts are of frequent occurrence during the early acute stage of the disease. Vomiting, diarrhea, or constipation are frequently observed. Pharyngitis, bronchitis, rhinitis, and bronchopneumonia may occur. Angina is frequently accompanied by fetor ex ore. Stomatitis with increased flow of saliva has been observed.

Individual symptoms may vary in the same and in different epidemics. For example, Medin saw mostly constipation; Wickmann, vomiting and diarrhea. Müller saw in a large majority of cases marked vomiting, while diarrhea was rare. The symptoms vary in intensity. Thus, vomiting may occur only once or it may persist for a week. Stools may be profuse and frequent and of a greenish color. Severe abdominal pains have been recorded, not necessarily accompanied with meteorism. Very often there are lancinating pains originating at the spine and radiating over the abdomen resembling the agony of lead-colic. Swelling of the spleen has been recorded. Occasionally the liver is enlarged. Sometimes there is mild albuminuria. Attention is called to the fact that in many of the cases sweating is severe. Indeed, parents have emphasized this by saying that the perspiration was so profuse that the water literally poured

from the body and the child was as wet as though he had been immersed in a pool.

Blood Examination.—The blood findings are not uniform. At the very beginning of the disease marked leukopenia has been observed (3000 to 8000 leukocytes). The lymphocytes are usually increased. Others have recorded an early leukocytosis (10,000 to 30,000 leukocytes).

Skin.—Herpes has been observed, though it is rare. Herpes zoster has been noticed occasionally. Scarlatiniform and morbilliform eruptions have been recorded. Miliaria has been noticed, and is probably due to the excessive sweating.

Nervous Phenomena.—Restlessness and irritability are early symptoms. Marked pain is felt over the entire body. On account of the hyperesthesia children cry and resist if they are touched. They resent even the slightest passive movement. At times they complain of pains in the limbs, neck, and back. Very frequently in the early stages of the disease the patients are excessively drowsy. They show an irresistible desire to sleep. They sleep during the day as well as at night. They may be aroused for food or to evacuate rectum or bladder, and when awake are perfectly clear mentally, but very soon fall asleep again. In severe cases the drowsiness changes to stupor, and in severe toxic cases of the fatal variety terminates in coma. But, in contradistinction to meningitis, mental clearness continues even in the severest cases until the fatal end. Muscular spasm in certain muscle groups, particularly in face and extremities, may be noticed in the preparalytic stage.

Headache is not infrequent. Very often the entire head is involved, though pain in the occiput is most common. The pain is also observed in the back of the neck and along the spine. Opisthotonos is a common symptom. Shidler noticed pink lines under the eyes, running from the inner canthus outward and downward to the malar bone. A modified Kernig sign is observed on the third or fourth day.

Pain may be observed along the great nerve trunks. Photophobia is not an uncommon symptom. There may be disturbances of sensation in exceptional cases. Slight anesthesia

may be present. Temperature sense may be diminished or lost. Convulsions have been observed during the early stage, though they are rare. Tremor is not a common symptom. Ataxia has been observed in the early stages of the disease, though it very soon disappears, lasting only during the initial period.

Incontinence of feces resulting from temporary paralysis of the rectum has been observed. Urinary incontinence and retention appear during the initial stage, though either may be associated with paraplegia and may be more or less permanent.

The Paralytic Stage.—The paralysis frequently overtakes the initial symptoms or even the prodromal stage. Indeed, in severe cases the paralysis becomes manifest when the early symptoms are at their height. It must be stated as a general rule, however, that the symptoms of the initial stage tend to become less or disappear as the paralysis sets in. The fever, as a rule, diminishes as the paralytic stage becomes marked. Severe initial symptoms do not always indicate the severe type of the disease, though the reverse may be true and mild initial symptoms may be followed by severe forms of the paralysis.

Medin offers a clinical classification based upon extensive observation:

- (1) The poliomyelitis type.
- (2) The type which resembles Landry's paralysis.
- (3) The bulbar or pontine type.
- (4) The encephalitis type.
- (5) The ataxic type.
- (6) The polyneuritis type.
- (7) The meningitis type.
- (8) The abortive type.

This classification has not been accepted by all writers, though it seems to represent the clinical experience of many of the closest students of the disease. The most recent authors would abridge the classification of the ataxic type by combining numbers 3 and 4 under one head.

The Poliomyelitis Type.—Almost any group of muscles may be paralyzed. Most frequently the extremities are involved,

arms as well as legs. The paralysis of the extremities is preceded by weakness, and the legs, the peroneus, and the anterior tibial group are most frequently attacked. Next to the extremities the muscles of the trunk are involved, the muscles of the back as well as those of the abdomen. Paralysis of the abdominal muscles is frequently overlooked. If the latter muscles are paralyzed there may be a hernia of the abdominal contents in the paralyzed area, and this becomes more marked if the patient coughs. These patients, too, in this condition have difficulty in sitting up. When the back muscles are involved flaccidity of the spine is observed. The glutei are sometimes paralyzed. This condition is frequently associated with paralysis of the muscles of the back. Such patients find it necessary to support themselves by placing their hands upon their legs if they attempt to sit erect. The muscles of the neck may be involved. In this instance the prognosis is usually unfavorable. The respiratory muscles may be paralyzed, and likewise the intercostals and the diaphragm itself. The paralysis of these muscles may be unilateral. Where the intercostals are involved the visible movements of the thorax are limited and the act of respiration is performed by the diaphragm. If the diaphragm is paralyzed there is retraction on inspiration and protrusion of the epigastric region on expiration.

The paralysis may extend to the sympathetic nerves. Wickmann reported narrowing of the palpebral fissure and contraction of the pupil. Retraction of the eyeball has been observed. Vasomotor paralyses are recorded. Edema of the paralyzed extremities is occasionally observed. The paralyses are nearly always flaccid, the reflexes are markedly diminished or lost, electric excitability is diminished, and the reaction of degeneration occurs. In rarer instances the reflexes may be increased. These are the cases where the myelitis becomes diffuse and the pyramidal tracts undergo degeneration.

Landry's Paralysis Type.—Landry in 1859 studied a group of cases that occurred in adults which began with a paralysis of the lower extremities; the trunk became involved and eventually the arm. The process, ascending still further, involved

the bulbar centers, particularly those of respiration, until death terminated the illness.

The Bulbar and Pontine Form.—The disease need not necessarily be confined to the gray cells of the anterior horn of the cord. It may attack other parts of the spinal cord. We may go further than this, because we learn from clinical observations that the disease may attack the bulbar centers. Medin first called attention to this fact, and his observations have been frequently confirmed. The facial nerve is very often paralyzed. Medin described a case of bilateral facial paralysis. The oculomotor, the abducens, trigeminal paralyses (mouth could not be closed and lid reflex was absent), the glossopharyngeal, and pneumogastric nerves may be involved (in these instances respiratory disturbances occur associated with tachycardia and hoarseness). These lead rapidly to death. The spinal accessory and hypoglossal nerves may be involved.

In addition to these symptoms, nystagmus, irregularity of the pupils, disturbances of swallowing, paralysis of the palate have occurred in all the epidemics and are types well known to all students of this disease.

Encephalitis.—Pathologic examinations have shown that nearly all cases that come to autopsy show changes in the brain. The lesions may exist in the large ganglia, in the vertex, or in the meninges. These cases sometimes give no clinical symptoms. On the other hand, there is a very definite group of cases that give evidence of cerebral involvement, such as spastic hemiplegia, with athetoid and choreiform movement as residual manifestations later in the disease.

The Ataxic Form.—Only a few cases of pure ataxia have been described. It is probable that in these cases the lesion is in the cerebellum. These patients usually show an increase of the patellar reflex.

The Polyneuritis Form.—This variety may present itself as a multiple neuritis. It is difficult in many cases to determine whether the symptoms are spinal or peripheral in origin.

The Meningeal Form.—Meningeal symptoms may appear in the early stages of the disease. Headache, pain in the back

of the neck, and opisthotonus may be so prominent that meningitis offers the most probable solution of the diagnosis. If paralysis occurs the diagnosis is rendered less difficult. If an epidemic of spinal paralysis is under way the diagnosis is readily made. Lumbar puncture is of great value in the differentiation between the two diseases.

The Abortive Form.—In every epidemic mild cases are recorded. Meningeal symptoms are scarcely manifest in this group. Sometimes a child who has been exposed to the infection may become ill with fever, diarrhea, pains in the neck, fetor ex ore, bronchitis, and in two or three days he has recovered. In other cases there may be more marked symptoms, such as vertigo, backache, stiffness of the neck, pain in the limbs, tremor, uncontrollable desire to sleep, and mild opisthotonus, and in a few days recovery occurs without paralysis.

Adults are frequently attacked by this abortive form, though it is sometimes observed in children. Abortive types may be serious, and, while paralysis does not occur, bronchopneumonia or lobar pneumonia may complicate the disease and lead to a fatal termination.

The Reparative Stage.—About two weeks after the onset of the paralysis in typical cases the reaction of degeneration appears. During the early stage of the paralysis there may be diminution of the electric excitability, but in most instances there is a recession of paralysis in some groups of muscles and eventually mobility is restored in distal portions of the extremities. A child in whom both legs have been paralyzed begins to move the toes. The repair is manifested by gradual improvement in muscle power in the affected parts; the complete recovery in all of the muscles involved does not, as a rule, occur. The prognosis in some cranial nerve paralyses is more favorable than would be anticipated, for example: paralysis of the facial and hypoglossal nearly always recedes. Paralysis of the anterior tibial tends to persist. To a less extent and less frequently the quadriceps femoris is involved.

In the arms the deltoid, supra- and infraspinatus muscles, and the biceps tend to remain permanently paralyzed.

This reparative stage, as a general thing, lasts for eight weeks, though it may continue for three months. Indeed, some observers maintain it lasts for nine months. Muscles that have not repaired at the end of this time remain permanently paralyzed.

The Residual Paralysis.—Paralyzed muscles atrophy and may become the seat of connective-tissue replacement. Contractures may occur, particularly in the lower extremities, and club-foot, talipes equinus, and genu valgum may occur. The flaccidity of the joints is extreme. The knee may be bent in any direction. The limbs fail to grow or may become completely atrophic. The amount of calcium in the urine in the early stages of the paralysis is increased, indicating retrogressive bone changes. The skin is blue or livid and feels cool to the touch.

In the cerebral paralysis the atrophy is not marked, the reaction of degeneration does not occur, the spastic condition continues, and contractures occur. The reflexes are increased, rigidity of the extremities with athetoid or choreiform movements may persist.

PROGNOSIS

Formerly the opinion prevailed that the prognosis as to life was good, and that the chances for complete recovery were unfavorable. We know today that a considerable mortality attends the disease. Wickmann reports a mortality that varied between 10 and 42 per cent. Most of the deaths occurred on the fourth or fifth day. This author found that in children up to eleven years the mortality is $10\frac{1}{2}$ per cent., whereas in patients from twelve to thirty-two years the mortality is 7.6 per cent.

Netter's statistics show a mortality of 6 per cent. in children and 18.75 per cent. in adults. In the Norwegian epidemic the children affected showed a mortality of 11 per cent. In inoculated monkeys the mortality is 76.4 per cent. In the milder forms patients may recover with only a slight muscular disability. Every degree of paralysis may result as permanent effects—complete paraplegia or disability in the use of all the extremities—but atrophy may be mild or severe.

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

In the early stages of the disease many of the acute febrile diseases of childhood require consideration. We need only mention arthritis, neuritis, influenza, acute diseases of the respiratory and digestive tracts, typhoid fever, meningitis, and a host of others.

In differentiating from influenza it should be remembered that the catarrhal symptoms which are prominent in grip are insignificant in spinal paralysis.

In true neuritis the manifestations are usually bilateral, develop slowly, and are associated with sensory disturbances.

In meningitis the examination of the spinal fluid is of the utmost importance.

The spinal fluid in poliomyelitis exudes under some pressure in the early days of the disease. It is clear, the albumin content is somewhat increased, the cells are slightly more numerous, composed mostly of lymphocytes. The leukocytes are not much increased. Bacteriologically the fluid is sterile, in this way differing from meningitis. Headache is not so violent in poliomyelitis. In meningitis more or less unconsciousness is the rule.

In cases of difficult diagnosis the age of the child is of importance, and in the presence of an epidemic every febrile case should be carefully observed.

The clinical course of a case of poliomyelitis usually clarifies the diagnosis in a few days.

In the abortive type of cases the diagnosis at times can only be presumptive. The positive nature of the disease may be determined by inoculation experiments on monkeys.

PATHOGENESIS

Harvitz and Scheel, investigating the nervous system of 19 cases of acute poliomyelitis, found in the spinal cord a diffuse infiltrating inflammatory process closely related to the blood-vessels and chiefly in the gray matter of the anterior horn. Generally the inflammation extended along the whole length of the cord, but was most intense in the cervical and lumbar enlargements. The degeneration of the ganglion cells was very marked,

and extended rapidly over large areas of the cord. There were numerous leukocytes corresponding to the location of destroyed ganglion cells. The inflammation was generally more severe than was to be expected from the clinical symptoms, and the inflammation partook of a hemorrhagic character. Microscopic examination showed that the pia mater was first attacked and that the inflammation extended to the cord.

The inflammation reached its height in the anterior gray horns, presumably because they were supplied with the most numerous and largest blood-vessels. They also found more or less inflammation in the brain cells, the most extensive lesions being found in the medulla and in the pons.

TREATMENT

Prophylaxis.—If the disease is communicated by human contact, efficient prophylaxis will be very difficult when we consider that mild cases, abortive cases, and convalescents may carry the germs for years. These facts are taken into consideration and make it obvious that prevention is a difficult problem. The reporting of cases is necessary if quarantine is to be established. It is doubtful whether isolation of the sick has great value in the prevention of an epidemic. Experience seems to indicate that the disease is less spread by those who are sick than those who are well, though acting as hosts for the causative agent of the disease. We have already learned that during an epidemic great numbers of those who are apparently well are carriers without being in the least suspected. Owing to the fact that laundry, wearing apparel, and all kinds of household goods may carry the disease, disinfection of these articles should be insisted upon.

The matter of school attendance is under discussion. During a severe epidemic the school attendance would undoubtedly serve in distributing the disease. At any rate, those children who come from homes where there are other children sick with this disease should be prohibited from school attendance. Children's parties and entertainments and attendance upon moving picture shows and other performances should be interdicted. In cases where the disease terminates fatally funerals should be private.

The mouth and nose should be disinfected. Landsteiner and Levaditi found that menthol-in-oil or a powder of menthol, salol, and boric acid were useful in nasal disinfection. It has been shown also that 2 per cent. solutions of peroxid of hydrogen or solutions of permanganate of potash arrest the action of the virus, and would, therefore, be useful as prophylactic gargles. Dietetic errors should be avoided. It is possible that the infection may occur in the alimentary tract. Indigestion or lesions of the gastro-intestinal mucosa may open avenues for the entrance of the virus into the body.

Disinfection of secreta and excreta should be carried out. Handkerchiefs containing discharges from nose and throat should be carefully boiled. Gauze or cheese-cloth rags should be used as substitutes, and burned. Upon termination of the illness the house should be thoroughly disinfected. Formalin disinfection, it is thought, may be depended upon.

Vaccination against the disease has been suggested by Landsteiner and Levaditi. The dried cord and brain of poliomyelitis monkeys has been suggested. While immunity may be produced experimentally, the use of dried-cord substance for this purpose is not devoid of danger. Flexner and Lewis injected small quantities of the dried substance and produced immunity in monkeys. They pointed out, however, the dangers attendant upon this process.

During the acute stage of the disease quiet in bed is essential, and it is doubtful whether medicinal treatment has any favorable effect on the course. Cupping of the back by dry cups and the application of ice-bags has been suggested, though it scarcely seems of any avail.

As has already been pointed out, the acute stage is represented by an acute hematogenous myelitis. Hexamethylene-tetramine has been extensively advocated, though it is doubtful whether it has any decided effect. Flexner and Amoss have shown that the intraspinal injection of an immune serum is effective when introduced in the preparalytic stage and may prevent a poliomyelitis infection in a monkey.

The method is as follows: Twenty or 30 c.c. of blood is ob-

tained by venipuncture from a patient who has passed through an attack of poliomyelitis. The length of time after the attack is not important, for it has been shown that the blood preserves its antitoxic properties for several years. The serum is obtained by allowing the blood to clot and by centrifugalization. Lumbar puncture is now performed on the patient, and the immune serum introduced into the spinal canal.

During the acute stage the paralyzed muscle should be kept quiet and relaxed, so that its own action and that of its opponent should be prevented. In some cases where the limbs are painful and where there is muscle spasm a light, well-padded splint seems to steady the limbs and take the strain from unaffected muscle. Where pain is great, sedatives must be given for relief. Bromids, phenacetin, aspirin, codein, and occasionally hypodermic injections of morphin are necessary for relief. It is doubtful whether lumbar puncture has any effect in the cure of the disease. As soon as the pain has entirely disappeared mild massage may be begun. Contractures develop early, and they should be prevented if possible. The most common deformity is toe-drop, due to the contraction of the flexors and extensors of the foot in the absence of normal opposing muscles. Such deformity may be hastened by the pressure of the bedclothes. At times it is well to put a wire cradle over the affected limbs. The limbs may be supported by a light apparatus or by a sand-bag. The apparatus may consist of a posterior wire splint with a foot-piece at right angles.

It is possible, of course, to restrain the limb too much, prevent every movement, and atrophy from disuse may result. It has been recommended to employ the apparatus only at night, and to permit the limbs to be moved freely during the daytime. Massage is helpful during the early treatment. Passive and active movements of the muscles, especially active motion, is important. Muscle training should be begun early and should be persisted in. Electricity has been recommended. Galvanism should be used first, and faradism should be applied to the muscles.

The orthopedic surgeon should be called in early to co-operate

with the internist or physician. In this way the orthopedist would be enabled to begin early treatment for the paralyzed extremities.

Adrenalin intraspinally, recommended by Meltzer, of New York, is supposed to contract the vessels in the spinal canal, and in experiments made on monkeys diminished spinal cord inflammation. In the severe cases it has been supposed that life was prolonged though not saved by this remedy.

Muscle Tests.—Lovett has suggested a test for estimating the voluntary contractive power for individual muscles in infantile paralysis. Partial paralysis is the usual form. The muscle test measures the amount of damage done, and is also an index of the improvement which occurs under treatment. The device consists of estimating the strength of the various muscle groups by means of spring balances. The strength test is based on the patient's power to hold a position against the pull of a spring balance, and the resistance registered on the balance in the standard position represents the muscular strength. The pull is exerted from a sling attached to the member to be tested and the line of pull is at right angles to the long axis of the limb. The balance is hooked into the sling and the other end is held by an assistant. Two tests are taken and the larger reading recorded.

A table of normals for both arm and leg has been taken from children with unaffected muscles, ranging from four to eighteen years. This was necessary in order to show the variations that occurred in paralyzed muscles.

Muscle Training.—Lovett points out that muscle training as contrasted with simple massage gives the best results. It has been shown by an English writer that the most helpful exercise in infantile paralysis was to pull against the fully contracted muscle rather than to make resistance against the contracting muscle. Lovett and Martin report a number of cases to show that this form of treatment if continued for a long time gives the most beneficial results.

Serum Treatment of Poliomyelitis.—Flexner reports that the serum treatment has been imperfectly developed up until the

present time. Netter employed the serum from cases of poliomyelitis in which recovery from the acute condition had taken place even as long as thirty years previously. The serum injections were given subdurally as early after the appearance and recognition of symptoms as possible. The dose varies with the age of the individual; it should range from 5 to 20 c.c., and should be repeated several times at twenty-four-hour intervals, according to clinical conditions and indications. In the preparalytic stage one would expect the serum to act by diminishing the extent of the paralysis, and if paralysis has already occurred it should act in arresting it or preventing its spread.

The conditions surrounding the injection of the serum into the meninges are the same as those which are prescribed in epidemic meningitis. Before each dose of the serum is injected a suitable quantity of the cerebrospinal fluid is to be withdrawn, and the injection should be made slowly. The donor should be in normal health and his Wassermann test should be negative.

CLINIC OF DR. RALPH C. HAMILL

COOK COUNTY HOSPITAL

ACUTE ANTERIOR POLIOMYELITIS

Analysis of Three Cases Occurring in the Present Epidemic, Two of Them in Adults. Differentiation from Other Acute Paralytic Conditions. Occurrence of Cerebrospinal Syphilis and Poliomyelitis in the Same Patient. Possible Danger of Lumbar Puncture in the Meningeal Type. Prodromata and Onset. Pathology and Treatment in the Acute Stage and in the Degenerative Stage.

September 8, 1916.

At the time of an epidemic any consideration of acute diseases of the central nervous system must include acute anterior poliomyelitis.

Poliomyelitis shows itself in such a variety of ways that one might say the only symptom common to cases of this disease is the acute onset. In practically all cases the paralysis of some group of muscles or of the movements of some extremity comes on very acutely. This may be with or without marked prodromata, but only such as may occur in any acute infectious process. This is perhaps not exactly true, since among the prodromata there is almost always a predominance of symptoms pointing to irritation of the central nervous system. I say *almost* always. These symptoms are headache, irritability, stiffness of the neck, and indefinite pains in the back and extremities. Following a period varying from a few hours up to even a week or more of these prodromata the paralysis comes on, as I have said, very suddenly.

Prodromata.—Among the prodromata we must include evidences of disturbance on the part of the gastro-intestinal system,

such as diarrhea, vomiting, and epigastric distress. We must also include evidences of infection of the upper air-passages, such as head colds, slight sore throats, distress in the neighborhood of the sinuses, and bronchial symptoms, such as cough and marked expectoration.

The cases seen in this present epidemic of poliomyelitis form no exception to those described in the text-books so far as their prodromata or lack of prodromata are concerned, and so far as the onset of the paralysis is concerned. The paralysis may develop out of a clear sky, absolutely without prodromata, or the prodromata may be very severe and accompanied by a high fever, or there may be all degrees in between. The patient may awaken in the morning with the paralysis established, it having developed during sleep; the paralysis may come on in the midst of full activity, reach its maximum degree immediately, and after a period of a few days begin to subside; or the paralysis may appear in one part of the body, remain stationary for a few days, then appear in a different part, or finally it may assume the form of an acute Landry's ascending paralysis, beginning in the legs and rapidly involving the trunk, arms, and respiratory apparatus, with death occurring within forty-eight hours of the time of onset.

From these remarks you can readily see that it is very difficult to say just what will, what can, and what cannot happen in the early stages of acute poliomyelitis. I want to describe to you an undoubted case of poliomyelitis, a wholly probable case, and one somewhat questionable case. The circumstances that link these three cases together are the acuteness of onset, the wide distribution of paralysis, and the fact that they all occur at the time of an epidemic.

CASE I.—The first patient, a man aged twenty-two, was brought to Wesley Hospital on August 8th. The history which he gave was practically worthless because of the extreme difficulty with speech. I saw him later at the County Hospital, and got the following history after his speech difficulty had cleared up.

History.—About the 27th of July he began to have a severe headache, frontal and bitemporal. This headache came and went for two days. On the third day he felt pretty well. On the

fourth day he felt all right as he got up in the morning, dressed, and ate his breakfast as usual. In fact, he started out of the door to go to work, but just as he stepped out of the door an overpowering weakness seemed to settle down on him, his legs gave out from under him, and he fell to the floor. He tried to rise, but could not, and had to be helped into bed. He had no pain so far as he remembers. He remained in this condition of extreme "weakness" for between two and three days, then his speech became very difficult. He remembers no disturbance of swallowing, no regurgitation through the nose. In fact, as the examination later showed, the speech difficulty was laryngeal rather than pharyngeal. It was a disturbance of the vocal cords rather than of those muscles of the pharynx that serve both the swallowing and speech functions.

The *first examination*, made on August 8th at Wesley Hospital, revealed a paresis of the left side of the face, of the left arm, and of the lower limbs. The reflexes were described as brisk in the legs, but no clonus was demonstrable. The plantar reflexes were normal, the abdominal reflexes absent; the reflexes were present in the arms, but were more active on the right than on the left side. The patient could adduct, flex, and extend the left arm but feebly and with difficulty. All the movements of the right arm were preserved with fair strength. The face was pulled to the right upon attempting to talk. The tongue deviated slightly to the right side. There was no fever and the heart was normal. The chest was normal except for a few bubbling râles in the left lower lobe. The spleen was slightly palpable.

I saw the patient first on August 9th. At that time he presented a striking picture. There was the paralysis of the left side of the face which involved both the upper and lower divisions, a complete paralysis of all movements of the left hand; movements of the left elbow- and shoulder-joints were barely possible. All movements of the legs were very feeble; the legs would lie in almost any position they were placed in, giving you a queer impression of complete relaxation. This I wish to especially emphasize. There was a complete paralysis of the extensors of the right foot and toes.

The reason I emphasize the appearance of relaxation in the legs is because of the condition in which I found the reflexes. There was a bilateral Babinski sign, more marked on the left than on the right; there was an ankle-clonus on both sides, more prolonged on the left side than on the right; there was a left knee-clonus; the right knee-jerk was very brisk. The cremasterics and abdominals seemed normal, though perhaps those on the right were slightly better preserved than those on the left. It is this combination of relaxation, of flaccidity in the legs, with reflexes indicating involvement of the pyramidal tracts, that forms a striking and, one is tempted to say, pathognomonic feature of the case. There is an involvement of both the pyramidal tract and the anterior horn cells supplying the legs. Both the upper and lower motor neurons are involved. The reflexes in the arms are more in keeping with what we are led to expect in the presence of a flaccid paralysis. The left wrist-jerk is abolished, the right is barely demonstrable. The right biceps and triceps seem normal, the left are questionable or absent. The jaw-jerk is very brisk. Sensation, tested grossly, was normal.

Spinal fluid examination gave a positive Noguchi, a negative Nonne, and 10 cells to the cubic millimeter. The failure of the Nonne test is more probably due to faulty technic than to absence of globulin. There were 10,600 white cells present in the blood.

During the patient's two-day stay at Wesley Hospital he vomited several times, complained bitterly of headache, and ran a practically normal temperature. It varied between 98° and 99° F.; on one occasion only it reached 99° F. by mouth. Unfortunately, rectal temperatures were not taken over a sufficiently long time to give us unquestionable information.

The *second examination*, made at the County Hospital on August 10th, showed much the same findings. On August 12th catheterization became necessary because of retention. August 13th he was already improving rapidly—no joint was completely paralyzed and his speech had markedly improved. The headache was less severe, but the retention continued. Two days later urination was normal and the paralysis had largely settled

or confined itself to the muscles moving the right foot. The headache continued.

On August 11th the spinal fluid showed a positive Nonne and 22 cells, all lymphocytes, to the cubic millimeter. The blood showed 15,000 white corpuscles, only 70 per cent. being polymorphonuclears.

I examined him today (September 8th) as he was preparing to leave the County Hospital. He is very much improved. He walks with a slight swaying and with a scraping of the right foot, such as we see in a cerebral hemiplegia. As he lies down there is more or less constant clonus of the right calf muscles. The plantar reflexes are normal, the Achilles are brisk with a persistent ankle-clonus on the right side, a clonus which does not last more than a few moments on the left. There is a suggestion of a knee-clonus on the right side. Cremasteric and abdominal reflexes are normal; wrist-, triceps-, and biceps-jerks are normal, the jaw-jerk is brisk. There is a slight paresis of the left face, seen only when he attempts to show the teeth. The eyes are held squeezed shut against my efforts to open them, with equal force on the two sides. Dorsal flexion of the toes is weakened on both sides, especially the right. Otherwise there is no local weakness anywhere in the body. The prominence of the perineal group on the right side is less than that on the left. Unless one knew of the paralysis that had existed on the right side I doubt whether one would observe this suggestion, which is the only suggestion of muscular atrophy. Speech is normal. Mentality is normal except that the patient is very nervous. He sleeps none too well.

Diagnosis.—This is without question a case of anterior poliomyelitis. The foci of infection in the early stages were both in the upper and the lower segments of the cord. The anterior horn cells of the entire lumbar enlargement running down even into the sacral cord, the bladder center, were doubtless in a decidedly pathologic condition during the early period of the disease, hence the flaccid muscles of the legs. The facial paralysis, including as it did both the upper and lower divisions, showed an involvement of the motor cells of the seventh nucleus, the cells corresponding to the anterior horn cells in the cord. The flaccid

paralysis of the left arm with lost reflexes speaks strongly for an involvement of the anterior horn cells in the cervical enlargement. The disturbance of speech was due to an involvement of the cells of the vagus nerve controlling movements of the vocal cords.

I have spoken of the disease process as an involvement of the anterior horn cells. I do not believe that this is altogether the best way to speak of the pathologic process. It should be described rather—at least this is the view of many authorities—as a hematogenous intoxication, or a hematogenous infection, of the gray matter of the lower part of the central nervous system below the cerebrum. When seen in the acute stage the blood-vessels are the seat of a marked perivascular round-cell infiltration. Without doubt this marks the presence of the virus of poliomyelitis in the walls of the blood-vessels or in their immediate surroundings. A vessel surrounded by such an infiltration is obviously not in a condition to supply nutrition properly, and also is the container of toxic substances probably of microbic origin. Both of these conditions are bound to influence the anterior horn cells, complex bodies so dependent upon perfect nutrition.

In this patient we must assume that the disease process has spread beyond the gray matter to which it is ordinarily confined, or to which we think of it as ordinarily confined. The lesion in the bulb that involved the seventh nucleus and possibly the tenth must have also spread, so that to a degree it involved the fibers of the pyramidal tract also. We are led to this assumption by the presence of the brisk reflexes in the lower extremities and the bilateral Babinski sign. This distribution of the pathologic process, although not fitting into the ordinary picture of the disease, is not very uncommon in large epidemics. Dr. Arthur Dunn, of Omaha, described such findings occurring in the epidemic in 1910.

Wickman, in his large experience in two epidemics in Sweden, describes this involvement of the pyramidal tracts with consequent increase of deep reflexes in the legs.

CASE II.—The second patient, a little girl thirteen years of age, entered the County Hospital August 28th with a history of having eaten some sausage two days before. Twenty-four hours

later she had severe abdominal cramps and vomited several times. That evening she was seized with convulsions, following which she was unconscious until she was brought to the hospital. The family history is entirely negative. The rest of the family who had also partaken of the sausage were not affected thereby. Hence I think we can eliminate the sausage as the cause of the disturbance.

When examined at the County Hospital she was stuporous, but answered questions if they were persisted in. The pupils were very small, otherwise normal; eye movements were normal. The tonsils were enlarged and red. The submaxillary glands were palpable; there was no thyroid enlargement. There was a moderate amount of rigidity of the muscles of the neck. The head was held rather stiff, with the chin turned toward the left shoulder. Attempts to flex the head were very painful. In fact, rather than allow her neck to be bent she stiffened herself so that the whole body was raised from the bed when force was used. The pulse was markedly arrhythmic. All deep reflexes were normal at the time of this first examination. There were involuntary urinations daily. Five days after her entrance into the hospital the right side of the face became somewhat paretic.

When I first saw her on September 5th she was stuporous, the head was strongly retracted, all efforts to bend the neck were resisted, there was a suggestion of a choked disk on both sides, the pupils were pin-point, there was a Babinski sign on the right side, a suggestion of foot-clonus on both sides—more marked on the right—the knee-jerks were brisk, the superficial reflexes normal or diminished, and the deep reflexes in the arms diminished. The pulse was only 60 to the minute; this in spite of a slight rise in temperature. This combination of symptoms—the slow pulse, choked disks, the pin-point pupils, the retracted head, and the stuporous condition—all strongly suggest increased intracranial pressure. The slight paresis of the right side of the face points toward the localization of inflammatory action in the medulla, so we might say that we have two forces acting upon the medulla interfering with its normal function; namely, the pressure of the increased cranial contents, the swollen brain, and the

pressure action of the local inflammatory process. In view of these two forces, and in view of the tremendous importance of the proper functioning of the vital centers of the medulla, particularly those associated with the vagus nerve, great caution should have been exercised in the withdrawal of spinal fluid. This caution, unfortunately, was not taken when a lumbar puncture was done twelve hours after I saw the patient. A rather large needle was used, the fluid was allowed to escape rapidly, and more was taken than was wise, with the consequence that fifteen minutes after the spinal fluid was withdrawn the patient became unconscious and stopped breathing. Artificial respiration was applied, the pulse became imperceptible, but improved under the artificial respiration. Respiration was induced for eleven hours, the pulse gradually became weaker, and at the end of eleven hours the child died.

The spinal fluid contained a very marked increase in the cellular content. There were 180 polymorphonuclear cells to the cubic millimeter and the lymphocytes were increased. The fluid was a straw color and slightly cloudy. There probably were minute hemorrhages in the region of the fourth ventricle either before or induced by the spinal puncture. In all probability there was some diapedesis or some small hemorrhages antedating the lumbar puncture. A postmortem examination was refused.

Diagnosis.—This patient is a typical example of what is known as the *meningeal type of infantile paralysis*. The meninges diffusely, or in a disseminated manner, show the same hyperemic perivascular round-cell infiltration and small hemorrhages that the cord substance itself shows. That the cord substance also was involved, or at least the parenchyma of the central nervous system, is evidenced by the swollen optic nerves, the myotic pupils (signs of cerebral irritation), the paretic right face, and the right-sided Babinski (evidence of involvement of the pyramidal tract). That the meninges were markedly involved is evidenced by the large number of white cells in the spinal fluid. One might ask whether the statement that the white cells were increased is justified in the presence of blood in the spinal fluid, but the

amount of blood that was present was altogether insufficient to produce as many cells as were found.

Before discussing the disease in a systematic manner I wish to show this third case, which may or may not be infantile paralysis. I am not prepared to say.

CASE III.—This colored man, forty-three years of age, a laborer by occupation, was admitted to the County Hospital on August 29th, and gave the following history at that time.

History.—He said that he was perfectly well up to about seven weeks ago; that he then suddenly lost the use of his arms and hands while at work. He was loading bricks in a wheelbarrow when he suddenly felt a sensation of excessive weakness come through his chest and run down his arms. He tried to pick up the handles of his wheelbarrow, but was unable to hold on to them and had to stop work at once. The paralysis of the arms seemed to get better after a few weeks, especially on the right side. During this time he suffered a dull, aching pain in the region of the left axilla. During the two weeks previous to his entrance he noticed a difference in the size of his arms. He even says that his left arm had improved but little, whereas his right arm is now practically normal. When we examine him we see how unreliable such a man's testimony concerning his own condition is.

His family history is negative. His wife is living and well. There are no children.

This history would lead one to suspect infantile paralysis. Here we have the sudden onset with paralysis without great pain, fairly well localized in the arms, and improving after a short period. Careful questioning, however, brings out certain other points. He says that for a month before the actual onset of the trouble he had been having cramps in the hands off and on. These cramps came only while at work. They were not particularly painful; they would merely close his fingers, and he would have to use force to straighten his hands out. About a year ago he noticed that when he felt a desire to urinate if he could not get to the toilet quickly he would occasionally lose his urine. About eighteen months ago he first noticed a diminished sexual power. Now he has practically none. Last winter he had attacks of

"rheumatism"; that is, sharp, shooting pains through his knee-joints. These might come on only once every two or three days, and between the attacks he would be quite free. There is an indefinite history of double vision lasting for two or three days in the last three or four years.

More careful questioning concerning the signs of weakness reveals the fact that it came as a sensation of choking with a sense of constriction. During the course of an hour this sense of weakness progressed down the arms and into the hands. The weak-



Fig. 92.—Note flattening of right triceps, also the hair in the right axilla made visible through atrophy of the pectoralis major.

ness was entirely without pain at the time of onset. There was a numbness and "needles-and-pins" sensation in the little and ring fingers of the right hand, running also into the ulnar border of the hand.

Physical Examination.—Inspection reveals a very powerfully built, middle-aged colored man. The pupils react normally, the fundi are normal, movements of the eyeballs and of the cranial nerves in general are normal. You notice the very peculiar appearance of his arms, especially the right. The muscle all seems to be on the front of the arm; as he holds it up here is this bulging

biceps and almost no triceps (Fig. 92). The outlines of the right scapula are more evident than the left. The spinous border protrudes a little further from the chest wall, the infraspinous space is a little bit flattened, and the muscle mass running from the chest wall to the arm, forming the posterior wall of the



Fig. 93.—Note the position of the left hand, due to atrophy of the flexors, and small hand muscles. The grooved first interosseous space is clearly shown. The left forearm is smaller than the right.

axilla, is notably decreased on the right side. What is true of this posterior wall of the axilla is still more true of the anterior wall; that is, the muscle mass made by the fibers of the pectoralis major, and as you look at his chest you see very quickly that the mass of the pectoralis—very large on the left side—is almost gone on

the right (Fig. 92). The trapezius group seems normal and equal on the two sides. The biceps and deltoids are little, if any, changed. The extensor swelling of the forearm—that is, the muscle mass of the radial and dorsal sides—is well preserved



Fig. 94.—Left hand shows flattening of the thenar and hypothenar eminences. The ulnar side of the left forearm is distinctly flattened, due to atrophy of the flexors. The right hypothenar eminence is distinctly flattened, as is the ulnar border.

(Fig. 93). There is, on the other hand, a marked flattening of the flexor mass—the muscles of the anterior and ulnar portion. The left hand is very thin; the thenar and hypothenar eminences have practically disappeared (Fig. 94). The interosseous spaces

are markedly furrowed. There is evidently some atrophy also of the muscle groups of the right hand, but not to nearly the same degree as of the left. Occasionally we see a fibrillary twitching going on in the right teres group. The lower extremities are apparently normal. The abdominal muscles are normal. The plantar reflex on the left side is normal; it is not so frank on the right. The Achilles reflex is absent in the left leg, but is demonstrable in the right when reinforcement is used. The knee-jerks are brisk. The cremasterics and abdominals are normal. The biceps are barely demonstrable, the wrist-jerks and triceps are absent. There are no disturbances of sensation.

Electric examination shows a loss of reaction to the faradic current in the right pectoralis major, both triceps, the right teres major and minor, infra- and supraspinatus, and the right latissimus dorsi. There is no faradic response of the right flexors or extensors. There is the typical sluggish contraction, typical, I mean, of the reaction of degeneration to the galvanic current in these muscles where faradism fails to produce a reaction; namely, the right pectoralis major and minor, the right triceps, and the right interossei. The reaction of the left triceps is approximately normal. In the extensors of the forearm the galvanic response is not as brisk as one expects normally, yet is not very sluggish. The flexor groups of the arms, both right and left, are distinctly sluggish.

On the buttocks, just to the right of the anus, there are two indolent pustules such as are frequently seen in syphilis.

The spinal fluid shows 7 cells to the cubic millimeter. The Wassermann reaction is strongly positive on both the spinal fluid and the blood.

This patient has syphilis without doubt. I am led to this conclusion by the positive Wassermann tests, the history of urinary disturbance, sexual disturbance, "rheumatism" which suggests the pains of tabes, the lost ankle-jerk, and the suggestive gluteal skin lesions. Have we also infantile paralysis?

In connection with this question I would like to cite a case I saw yesterday in the infantile paralysis ward: A man fifty-three years of age, who had syphilis a good many years ago, who has

Argyll-Robertson pupils, the right pupil being pin-point, the left dilated, with positive Wassermann findings. In other words, this man has an unquestionable cerebrospinal lues. A few days before his entrance to the hospital a flaccid paraplegia came on very suddenly without marked pain, a day or two later ptosis of the right eyelid developed, and these symptoms persist at the present time. His paraplegia I consider in all probability due to poliomyelitis for this reason, that while he has an almost complete motor loss with lost reflexes, there is almost no sensory disturbance. If the flaccid paraplegia were due to a syphilitic myelitis, a transverse myelitis, we would certainly expect to find a marked disturbance of sensation. Coming on, however, in the midst of an epidemic, and in view of the absence of sensory disturbance, I feel that we cannot with justice exclude poliomyelitis in this case.

Such a combination was described first, so far as my knowledge of the literature is concerned, in 1904 by Léri and Wilson. The diagnosis of the two conditions was made antemortem and postmortem findings were confirmatory. This also was in an adult.

One can conceive no reason why the two diseases should not be present in the same individual. In fact, when we think of how often we call in the idea of *locus minoris resistentiæ* to explain the localization of a hematogenous infection, we are justified in thinking that a central nervous system already affected by syphilis would be more easily affected by infantile paralysis than one that was not luetic.

Differential Diagnosis.—In our patient of today the very sudden onset rules out all but a very few conditions. I think we can discard hysteria without another thought. We have merely to look at his muscles. Can it be a hemorrhage into the cord? Hemorrhage of the cord is not uncommon in syphilitic myelitis, but hemorrhage of the cord has a tendency to involve especially the central substance of the cord. Sensory disturbances are the rule, with a tendency to a syringomyelic dissociation. In a hemorrhage also we would expect a Babinski toe phenomenon, owing to involvement of the descending motor tracts; that is, I

would conceive that we need think of a hemorrhage only of the cervical region. A hemorrhage also would not show the tendency to pick and choose among the muscles in the manner present in this case. The well-preserved deltoid would scarcely be found lying next to the very atrophic triceps. I am inclined, therefore, to rule out hematomyelia.

Multiple thrombi in syphilitic vessels are conceivable as coming on simultaneously over a rather large area of the cord and involving only the branches of the anterior spinal artery (those which supply the central gray matter of the cord). Syphilis more commonly involves the meninges, and especially the posterior meninges; therefore we would expect thrombosis to occur in those vessels which run in from the periphery of the cord. Such a pathologic lesion would surely be accompanied by signs of involvement of the pyramidal and ascending sensory columns of the cord.

The probability, then, is against the muscular atrophy found in this man being due to syphilis. The acute onset, the rather characteristic dull aching pain, not very severe, the irregular distribution of the involved muscles, and the improvement which he declares has taken place in the right arm, all speak strongly for poliomyelitis grafted on a preceding syphilis. We must keep him under observation for a few months. In case poliomyelitis is the causative agent even greater improvement is to be expected. Such improvement or failure thereof will settle the diagnosis. In the meantime, of course, antisyphilitic measures will be strongly pushed. Syphilitic muscular atrophies, however, do not clear up nearly as kindly as do those due to poliomyelitis.

Pathology of Poliomyelitis.—In speaking of the diagnosis in connection with the first case I gave a brief description of the essential pathology of the central nervous system in poliomyelitis. To recapitulate, the essential process is the perivascular round-cell infiltration, hyperemia, and edema. According to Wickman, this begins around the veins of the central gray matter. According to other authors, the capillaries of the anterior spinal artery are first involved. At any rate, it is a perivascular inflammatory exudate occurring chiefly in the anterior gray matter of

the spinal cord. That it involves also the cellular elements—that is, the gray matter of the medulla, the pons, and the crura cerebri—is evidenced by the occurrence of paralysis of the muscles supplied from these regions; that is, the facial, the tongue, the laryngeal, and the oculomotor muscles. There are many cases of encephalitis occurring during epidemics of poliomyelitis where the pathological picture presents essentially identical characteristics. In other words, the gray matter of the cerebrum is also vulnerable to the attacking micro-organism.

In the very earliest stages of the disease this inflammatory reaction is the predominating feature. Soon, however, changes begin to occur in the ganglionic cells of the anterior horns due either to the toxins of distant micro-organisms or to direct invasion of the cell by the germ. (The phagocytic invasion of the cells strongly suggests the direct germ action.) There is a loss of their characteristic intracellular markings, an invasion of their substance by phagocytic cells, and eventually their replacement by scar tissue.

When the disease process spreads out beyond the elements of the gray matter similar perivascular inflammatory appearances are seen in the white columns of the cord. I might say right here that perhaps the reason the disease is largely confined to the gray matter is that the gray matter is very much the more vascular of the two. Where, however, the white columns have been affected there is a destruction such as we find about any acute infectious process, inflammatory tissue, edema; myelin, and eventually axonal destruction. If the inflammatory reaction is not sufficient to cause fatal disease of the myelin, and subsides in a short time, the white columns may escape without lasting pathologic change.

The same perivascular inflammatory reactions are seen in the vessels of the pia. Hence the meningeal symptoms, the stiff neck, hypersensitiveness, root pains, and the changes in the spinal fluid.

How does this infection get to the central nervous system? Both the hematogenous and lymphogenous routes have been upheld. There is nothing positive either way. The point of entrance of the micro-organism has been located in the upper

air-passages by most workers. Certain inflammatory reactions in the walls of the intestines, accompanied by striking gastro-intestinal prodromata, have suggested the lower alimentary canal as the point of entrance. There is nothing sufficiently definite to suggest the spread of poliomyelitis by food products, such as milk, in a way comparable to typhoid. On the other hand, the micro-organism has been found in the dust of the patient's room and in the nasal passages of most if not all of the people coming into intimate contact with the patient. These latter facts suggest personal transmission through the upper air-passages. The micro-organism itself is very small. It has the faculty of growing in or passing through the Berkefeld filter. It has been described as an ovoid body, $\frac{1}{4}$ to $\frac{1}{2}$ micromillimeter in diameter.

As you all know, there is an epidemic of poliomyelitis at the present time in America. Its chief center seems to be New York. The health authorities of Chicago say there is no epidemic here; that is merely a manner of expression. There is an epidemic, and how many cases are overlooked no one knows.

As I have hinted, in these epidemics all sorts of unusual forms are seen. Wickmann classifies the forms as follows: Spinal, Landry's ascending paralysis, bulbar or pontine, encephalitic, ataxic, neuritic, meningitic, and abortive. The spinal is the most frequent, and it is the variety that gives the name to the disease, "myelitis." None of these forms are necessarily pure. In case the onset is severe there is undoubtedly an involvement of practically the entire central nervous system, which in the course of a week or ten days passes off almost entirely, leaving only a group of muscles or a limb affected by the destruction. The first case was a ponto-spinal case, and because all the paralyses are disappearing also an abortive case. The second case was a meningo-pontine, and the third a pure spinal case.

The onset, so far as its intensity is concerned, is no criterion of the final outcome. It may be practically identical with that of acute cerebral meningitis or it may be almost without symptoms. The fever frequently present at the onset may last for from a few hours up to a week or two. The paralysis may all come on at first, or may reach its maximum intensity in twenty-

four hours; it may involve different parts of the body, each new involvement following the preceding one by a period of several days. The first case is an example of this last variety, first the paralysis of the limbs, two days later laryngeal paralysis, then three days later involvement of the bladder.

I think I have already said enough of the distribution of the paralytic symptoms. I would merely add that the legs are much more frequently involved than the arms; the extremities than the trunk and cranial nerves.

The atrophies may reach their maximum intensity if they are not going to be severe, within a few weeks. In case the destruction is severe, the atrophy goes on for a period of several months.

The action of the antagonists—that is, those muscles opposed to the paralyzed ones—is of great importance. It has been shown that when a muscle contracts its opponent or antagonist relaxes. In infantile paralysis the normal tonus of the unparalyzed muscles results in their being hypertonic when considered in relation to their paralyzed agonists; that is, if the triceps is paralyzed (agonist) the biceps (antagonist) has a tendency to contract. Such actions as this produce marked deformities of the joints acted upon. A paralysis of the gluteal muscles is quite common. Then the contraction of the flexor muscles of the thigh has a tendency to produce a deformity which can only be overcome by marked lordosis; that is, the thighs are flexed forward, and when the individual attempts to stand the pelvis has to tip markedly in order to overcome this contraction. If the peroneal group is paralyzed, the calf muscles produce a talipes equinus, etc.

The **treatment**, so far as the final outcome is concerned, must take into account this action of the antagonists. The joints must be put at rest in such a manner as to prevent this faulty action. Also, considering the fact that the anterior horn cells are being very poorly supplied with nutrition, are far below their normal ability to keep up physiologic tonus in the muscles, extra strains upon this tonus must be avoided. One can conceive that one reason why the peroneus group is so frequently involved

is because the weight of the foot plus the weight of the bedclothes drags upon the extensor muscles. This calls for greater activity on the part of the anterior horn cells supplying these muscles than the cells are able to manifest. Consequently they give out and the muscle is lost. Rest, therefore, during the acute period is the most essential indication. Rest in bed may be sufficient. Plaster immobilization may be resorted to to advantage.

The immobilization should continue for a long time. The most satisfactory results are to be obtained by immobilization in a position giving the greatest relaxation to the paralyzed muscle. For example, if the biceps is paralyzed the arm should be put up in rather a high degree of flexion; if the triceps is paralyzed, in extension.

With the joint held immobilized during the periods of rest, and the immobilization removed once or twice a day and passive movements used, the muscle has the best chance to regain some degree of its function. These passive exercises should not be begun for at least three weeks after the subsidence of the acute period. With passive movements, gentle massage and galvanization of the paralyzed muscle should be used. It is of great importance that the massage should be *gentle*. The degenerating muscle will not stand rough treatment. Galvanization should be used just as passive exercise is once or twice a day for a few minutes. The use of these forms of treatment must be kept up for many months before confessing that more cannot be accomplished in helping the muscle back to strength. Children stand the galvanic current rather poorly. The use of large electrodes may help some where burning is complained of.

In case the meningeal manifestations are extreme, repeated lumbar punctures are certainly indicated, care being taken to avoid such unfortunate experiences as that of our second case. Hexamethylamin has been advised, but it is a question as to whether it does any good or not. Aspirin may be used for the pains, but morphin may be necessary. Intraspinal injections of 5-c.c. doses of serum, obtained from the blood of an individual who has recovered from poliomyelitis, are certainly advisable in

the acute period of the disease. After the inflammatory period is passed they are useless. Flexner strongly advises their use, three or four doses to be used at daily intervals.

In the degenerative final stage of the disease orthopedic apparatus may help greatly in the treatment of these cases. If contractures and joint deformities have been avoided or prevented some re-education of the muscles is possible. This depends entirely upon the degree of the destruction.

CLINIC OF DR. CHARLES LOUIS MIX

MERCY HOSPITAL

TWO CASES OF PRIMARY PERNICIOUS ANEMIA

Discussion of the Blood Picture in this Disease. Differentiation From the Aplastic Type. Spinal Cord Changes Occur in 60 Per cent. (1) The Tabetic Type; (2) The Ataxic Paraplegic Type. Reasons for Considering Pernicious Anemia of Infectious Origin. Possibility of Its Being on A Spirochetic Basis. Analogy to Syphilis. Treatment With Neosalvarsan and Sodium Cacodylate.

April 4, 1916.

CASE I.—I cannot show you this patient because he is too ill to be brought into the amphitheater, but there is nothing so far as his physical examination is concerned that I cannot tell you. He shows a typical lemon-yellow color, without a trace of pink or red. The rather elaborate blood findings put upon the board by the intern show clearly the blood picture of pernicious anemia, and afford us the data for a differential diagnosis between secondary anemia and primary pernicious anemia.

The patient is now on his final visit to the hospital. He has been here before, and left, as many do, only temporarily restored to partial health. When he first returned you will notice that he had 2,176,000 red cells and a hemoglobin percentage of 50. The first thing we have to do in such a case is to calculate the color index. With 2,176,000 red cells he had 50 per cent. hemoglobin. Roughly, 2,176,000 red cells should contain about 40 per cent. of hemoglobin. Therefore the color index is the amount of hemoglobin which he actually has divided by the amount of hemoglobin which he theoretically should have, which in this instance is 50 divided by 40, which gives 1.25. A color

index above 1.0, or unity, is characteristic and almost pathognomonic of pernicious anemia. It means that nature, knowing apparently the great reduction of red cells, is trying her level best to put all of the hemoglobin possible into each of the red cells, so that the hemoglobin will be somewhere near the normal even if the red corpuscles are not. That means that every single corpuscle has in it on the average 25 per cent. more hemoglobin than it normally should have. Nature always tries to compensate; she compensates in the lung, in the kidney, in the heart, and she compensates in the blood by an overproduction of hemoglobin. Therefore we have the disproportionate increase of hemoglobin, and we at once know that there is something seriously wrong. Just as hypertrophy of the heart means disease, so overproduction of hemoglobin means disease.

Let us examine another blood count. It shows 1,216,000 red cells. Now, if 5,500,000 cells contain 100 per cent. hemoglobin, 1,216,000 cells should contain x per cent. of hemoglobin by the following proportion: $5,500,000 : 100 :: 1,216,000 : x$. Calculating x , we find it to be 22 per cent. As the actual determination of hemoglobin showed the patient to have 40 per cent., his color index calculated upon the blood count is 40 divided by 22, or 1.82. This means that on an average each red cell contains 82 per cent. more hemoglobin than it should contain. *Such a high color index always means pernicious anemia.*

The next examination of the blood showed 1,300,000 red cells, with 40 per cent. hemoglobin. This, when computed, gives a color index of 1.69. The next count gave 1,280,000, with 40 per cent. hemoglobin. This number of red cells demands only 23 per cent. of hemoglobin, so that the color index is 40 divided by 23, or 1.74. The next examination, made October 11, 1915, gave 2,008,000 red cells, with 55 per cent. hemoglobin, giving a color index of 1.53. I will not stop to confirm the rest of the findings, but you will find that in all instances the color index is above unity.

If nature is gorging the red corpuscles with hemoglobin, what is the inevitable consequence? Why, that many of the red cells must inevitably be very big cells to accommodate the increased

amount of hemoglobin. Such a hypertrophied red cell is called a *megalocyte*. There is a diagnostic rule that in pernicious anemia the megalocytes should equal or exceed 40 per cent. of all of the red cells found, and in this long list of blood findings upon the blackboard there are only three apparent exceptions to the rule, and they are not really exceptions. An intern must be very expert in estimating the average size of red blood-cells if he is able to tell by his eye a megalocyte from a normocyte (a normal red cell), when that megalocyte is only slightly larger than a normocyte. To be absolutely accurate he should measure with a micrometer every one of the doubtful corpuscles. But in these very numerous blood examinations the intern, even without measuring the borderline corpuscles, but merely by estimating their sizes with his eye, finds that in all but three of these examinations the megalocytes exceed 40 per cent. of the total of all red cells. If he had actually measured the cells in these three instances he probably would have found the percentage to be 40 per cent. or even more. The rule holds very firmly in the great majority of all cases of pernicious anemia.

Careful differential white counts in cases of pernicious anemia illustrate another law. It is not so absolute as the law of the color index and the law of the proportion of megalocytes, but it holds in the great majority of white blood counts. It is the law that there is a reduction of the polymorphonuclear cells and an increase of the lymphocytes, both large and small. In pernicious anemia we usually have a polymorphonuclear count running 45 to 55 per cent. instead of the normal 65 to 70 per cent.; and a lymphocyte count running 35 to 45 per cent. for the small lymphocytes and 10 per cent. for the large mononuclear cells, instead of the normal 20 and 8 per cent. respectively. You occasionally also find in pernicious anemia the appearance of myelocytes, indicating a very grave blood disturbance, with the bone-marrow trying vainly to throw into the blood enough new blood-corpuscles, or as many as possible, to compensate for the loss.

So the third law in the diagnosis of pernicious anemia has to do with the relative proportions of the white cells. The first

law is that the color index is above unity; the second law is that there is an increase in the megalocytes; the third law is the reduction of the polymorphonuclears and the increase of the lymphocytes. Besides these three things which are essential in the diagnosis of pernicious anemia there is a fourth finding, not always constant, namely, the normoblast and the megaloblast. Normoblasts are nucleated red cells of normal size and megaloblasts are nucleated red cells of large size.

There are two types of pernicious anemia depending upon these normoblasts. One is the usual primary pernicious anemia and the other is aplastic pernicious anemia. The difference is that in ordinary pernicious anemia there is a marked tendency for the blood to renew itself, whereas in aplastic anemia there is no effort on the part of the body, no attempt whatever, to make new blood. You may in a given case start with a blood examination showing 3,000,000 red cells, and on the next count find 2,500,000 red cells, and then 2,250,000—every count being lower than its predecessor. But, more important than this, *you will never find a nucleated red cell*. There is a complete surrender on the part of the bone-marrow—it does not produce a single red corpuscle. These are the most malignant cases of pernicious anemia that you can find. I saw such a case two years ago in August, and he died in October. Not a single nucleated red cell was ever found in many very careful blood examinations. Not a trace of repair was ever noted. Pernicious anemia is bad enough, but aplastic anemia is ten times worse. There are not many cases of this type fortunately, but it is well to know them, so that when you meet them you will recognize them.

There is a fifth laboratory finding in pernicious anemia, and that is the poikilocytosis or red cells of irregular and bizarre shapes. It is natural that there should be differently shaped corpuscles because of the haste of repair and the failure in accuracy of manufacture in the vain attempt of nature to restore the corpuscles at once to the blood.

So we have as the blood findings in pernicious anemia, first, the color index, which is above unity; second, the increase in the megalocytes; third, the reduction of the polymorphonuclear cells

column of Gowers situated on the side anterior to the direct cerebellar tract (illustrating a cross-section of the spinal cord on the blackboard). In pernicious anemia, as a rule, there is only one part of the spinal cord which is affected, and that is the posterior portion, comprising the columns of Goll and Burdach, the blood-supply of which is not quite so efficient as the supply of the anterior portion. In a smaller number of cases not only is there disease of the columns of Goll and Burdach, but there is also an involvement of the pyramidal tracts.

If pernicious anemia affects only the columns of Goll and Burdach, the physical findings are very like those of tabes. In the columns of Goll and Burdach there pass up to the nuclei in the medulla, previous to their being relayed still further up through the fibers of the fillet, a lot of impulses from the muscles and joints, and these impulses give to us our knowledge of the location of our joints and muscles. This knowledge constitutes our muscle-and-joint sense. A patient with tabes who has a sclerosis of the columns of Goll and Burdach does not know where his legs are. That sounds like a strange statement, but when a patient tells you that he wakes up in the night and lights a match and hunts around for his legs to see whether they are out of bed or covered up, as a patient once told me, you will appreciate the function of these columns. It is because the columns of Goll and Burdach are blocked, because no impulses of muscle-and-joint sense pass up to the brain, that tabetics are ataxic. They are not paralyzed as to power in the legs, but they cannot use their legs correctly because they do not know where they are. Not paralysis of motion but control of motion is the faculty which is lost.

In the extreme bottom of the columns of Goll and Burdach are located a large tract of tactile fibers, and if it happens that the depth of the involvement of these columns is great, then tactile losses are associated with the muscle-and-joint sense losses, and these patients also become the victims, first, of paresthesias during the stage of irritation, and, finally, of anesthetics in their lower extremities, when the stage of blockade of tactile impulses has been reached. So in cases of tabes you have the loss of the

muscle-and-joint sense and the various paresthesias and anesthesias in severe cases.

Furthermore, you always have loss of ankle- and knee-jerks. The reason for this is that the reflex arc for these reflexes passes by way of the columns of Goll and Burdach, and if these columns are blocked then the knee- and ankle-jerks disappear.

In the majority of cases of involvement of the spinal cord in pernicious anemia these are the changes that you meet with; they are absolutely the same as the changes met with in tabes. It makes no difference whether it is tabes that is involving the posterior columns or whether it is pernicious anemia, the symptoms must be the same. But there is one great differential point which permits you always to separate the cases of tabes from those of pernicious anemia, and that is, that in tabes the pupils become involved.

In tabes you have the Argyll-Robertson pupil, which reacts to accommodation and not to light, and the pupils are usually very small, a contracted pupil, the pupil of spinal myosis as it is called. In cases of pernicious anemia, on the contrary, the pupil is of ordinary size and it reacts both to light and accommodation. Moreover, in cases of tabes there is usually an involvement of other cranial nerves; for example, of the third nerve—with ptosis or a squint; or of the sixth nerve—with internal strabismus; or of the seventh nerve—with a little facial weakness. Many of the cranial nerves become involved in cases of tabes at one time or another, but not in cases of pernicious anemia. The differentiation is very simple. Tabes has the Argyll-Robertson pupils and lacks the blood-picture; pernicious anemia has the blood changes, but does not have the pupillary disturbances. In every other respect the symptoms of the two diseases are exactly the same, and, therefore, this type is called the tabetic type of cord change in pernicious anemia.

There is another type of cord change in pernicious anemia, the *ataxic paraplegic type*. There may be an involvement not only of the columns of Goll and Burdach but also of the pyramidal tracts, and then a set of symptoms develops totally unlike those of the tabetic type. First of all, it will be well to mention

what happens in involvement of the pyramidal tracts alone. Such cases are frequent, and they are known as *spastic spinal paraplegia*. The name carries with it the symptomatology. When you say "spastic" you mean that there is a stiff paralysis; when you say "spinal" you mean that the spinal cord is involved; and by "paraplegia" you mean that both legs are paralyzed. The symptomatology is very simple. There being no sensory tracts involved, there are no sensory symptoms. There is only stiffness and paralysis of the lower extremities. These symptoms are always associated with exaggeration of the knee- and ankle-jerks, because the inhibitory messages which come down through the pyramidal tracts from the brain and which inhibit or tone down the knee- and ankle-jerks under normal conditions cannot get through the diseased pyramidal tracts; the result is that the knee- and ankle-jerks are increased.

With the increase of these reflexes there are usually three other things. One of these is the Babinski toe phenomenon, in which the big toe turns up when the outer surface of the sole of the foot is stroked. The other two things that may be present are ankle and patellar clonus. The ankle-clonus is apt to be present in the more advanced cases, the patellar clonus only in the most advanced. So you have the exaggeration of the knee- and ankle-jerks, the Babinski toe sign, and ankle and patellar clonus. If you add these symptoms of disease of the pyramidal tracts to the symptomatology of tabes, which is due to disease of the columns of Goll and Burdach, you merely get the addition of the symptomatology of the spastic paraplegia to the symptomatology of tabes. There is one thing that you must remember, and that is that when both the columns of Goll and Burdach and the pyramidal tracts are involved, the behavior of the reflexes is governed not by the involvement of the columns of Goll and Burdach, but by the involvement of the pyramidal tracts. Therefore, in ataxic paraplegia, where there is disease of both the columns of Goll and Burdach and of the pyramidal tracts, you will find exaggerated knee- and ankle-jerks, the Babinski toe sign, and possibly both patellar and ankle-clonus, simply because the thing that governs in these respects is the condition of

the pyramidal tracts. This type of cord change is known as the posterolateral type of cord involvement in pernicious anemia. The symptomatology consists of, first, the ataxic tabetic symptoms, then the tactile symptoms from the involvement of the touch fibers at the base of the columns of Goll and Burdach, and then the motor disturbances—the spasticity with the paralysis and the increased reflexes and Babinski toe sign from the involvement of the pyramidal tracts.

Sixty per cent. of cases of pernicious anemia show cord symptoms. Such a complication used to be considered as very unusual, but as time has gone on we have found that about 6 out of every 10 cases present cord symptoms, and I am inclined to say that before death a very much larger percentage than 60 show such symptoms. In examining a patient for very slight changes in the integrity of the columns of Goll and Burdach one must test out the muscle-and-joint sense. This you do by moving gently first one and then the other great toe with the patient's eyes closed. If he retains this sense he will know which way you are moving his great toe, but if he has lost this sense he will not know that it is being moved at all. If you will try this test in cases of pernicious anemia, you will find that nearly every case will show enough interference with the columns of Goll and Burdach to have lost the keen accuracy of response to the muscle-and-joint sense. He may still have the knee-jerks, but there will be a diminution of the sensitiveness of the muscle-and-joint sense. This is one of the earliest signs both of tabes and of involvement of the spinal cord in pernicious anemia and it antedates the loss of the knee-jerks.

Nature of Pernicious Anemia.—There remains one other point which is a matter of considerable importance, and that is, what is pernicious anemia? We call it primary pernicious anemia because we do not know what it is. I have long been of the opinion that it is an infection, and the arguments in favor of this opinion are very numerous.

In the first place, every case is associated with fever, and fever is ordinarily looked upon as a sign of infection. This is not necessarily so, because there may be enough interference with the

heat mechanism of the body in certain non-infectious cases to lead to increased temperature, as, for instance, in skull fracture. In these cases within an hour after the injury there may be a temperature of 104° F. But in the ordinary cases where we have fever, as we do in cases of pernicious anemia, running day after day and week after week, we must conclude that it is essentially an infectious fever.

Another reason for believing it infectious is the enlargement of the spleen, which takes place in many cases of pernicious anemia. The spleen has been looked upon as a blood-making organ, and has been said to be enlarged because of its huge endeavor in blood perfection; but, on the other hand, it is enlarged very markedly in most cases of infections. It is enlarged in cases of typhoid fever, syphilitic infections, and many other infections, and since it is also enlarged in many cases of pernicious anemia it seems fair to adduce such enlargement as an argument in favor of the infectious origin of pernicious anemia.

If it be infectious in origin, what kind of infection does it seem to resemble? My answer is, the spirochetic infection of syphilis. Both of these infections are destroyers of blood, though in unequal degree. In some cases of syphilis, however, there is a very surprising degree of hemolysis, so that pernicious anemia seems to be foreshadowed. Both run a low-grade fever, lasting for weeks and months at times. Both have moderate enlargement of the spleen in numerous individual cases and little or none in others. Both diseases yield to arsenic, spirochetes in general being susceptible to combinations derived from that element. Thus syphilis is now largely treated by neosalvarsan, salvarsan, and sodium cacodylate, and of all the remedies proposed for pernicious anemia these remedies give the very best results. The most striking improvement in pernicious anemia which I ever obtained was with neosalvarsan. The suggestion by Byrom Bramwell of this remedy several years ago was a very happy one. So we may infer, in a speculative sort of way, that the possible cause of pernicious anemia will some day turn out to be a spirochete of some sort. Just as the spirochete of syphilis long con-

cealed itself and finally was dragged into the light, so a spirochete of pernicious anemia may be discovered.

There is another important analogy between pernicious anemia and syphilis, in that they both affect the spinal cord in about the same way. Isn't this fairly easy to explain if they are due to kindred organisms? If they are, it is not strange that the cords are affected in much the same way. In pernicious anemia, it is true, there is, so far as we know at present, not much of an involvement of the meninges of the cord, whereas in syphilis there are marked meningeal changes. In general, physicians do not ordinarily make spinal punctures in pernicious anemia, because they are not essential to a diagnosis, but I have been making them of late, and have been finding signs of meningeal irritation. In a late case the cell-count showed twelve cells per cubic millimeter instead of four. In this fluid we found a positive Noguchi, Nonne-Appelt, and Ross-Jones reaction. These findings indicate a mild, chronic leptomeningitis. I think that with further studies of the cerebrospinal fluid in pernicious anemia a still further analogy between it and syphilis will be found, not only with respect to the columns of Goll and Burdach and the pyramidal tracts, but also with respect to the meninges.

Treatment.—The only remedy which is of value is arsenic in some form. It used to be given in the form of Fowler's solution, but now we give either neosalvarsan or sodium cacodylate. If the neosalvarsan can be obtained it is the remedy of choice; if it cannot be obtained, then sodium cacodylate may be used. The neosalvarsan is best given intravenously in full doses, fourteen or fifteen days apart, and five or six doses should be given if possible. Cacodylate of soda is best given in 3-grain doses twice a day for thirty days, with an interruption for a month or two, and then a second course may be given.

Pernicious anemia is a disease of remissions, which in some instances have lasted four or five years or more before a recurrence has taken place. Here, again, is an analogy between pernicious anemia and syphilis. Just as it is hard to get rid of syphilis, so is it hard to get rid of pernicious anemia. There may be three full acts before the final exit—two apparent cures. In giving a

prognosis, then, do not say that the patient is going to die soon, because he may live for several years, though he may, of course, live for only a few months. Rather tell the responsible relatives or friends that the patient has a disease which is incurable, but that it can be alleviated; that you may succeed in keeping him alive for a long time, though you cannot ultimately cure him.

April 25, 1916.

CASE II.—This gentleman is a private patient, who consented to appear before us in order that we may again take up a subject which we have in part been over.

The History (written November 3, 1914).—The patient came into the hospital in a wheel-chair. He is forty-two years old and married. His father died between seventy-five and eighty years of age from a general break-down. His mother died of diabetes at seventy-five. He has two sisters who are living and well; one of them had anemia, but recovered. Six brothers are living and well; one brother died, the cause of death being unknown.

Previous Illnesses.—He had the usual diseases of childhood. He had grip twice; once when he was sixteen at the time of the first big epidemic, and again two or three years ago, but this last attack was probably not an influenzal grip, but an infection of some sort.

Present Complaint.—The present illness dates back to three years ago (now nearly four and one-half years ago). The exact date and month of onset are not known. He first noticed a numbness in his hands, which was constantly present. He had tactile sensation in his fingers and hands, but he could not distinguish different objects which were put into them. This condition is known as astereognosis, an inability to identify objects placed in the hand. It is not necessarily due to sensory disturbance, because it sometimes occurs independently of sensory disturbances. If a man has a brain tumor in the superior parietal lobe he will have this symptom, because it is there that the various sorts of cutaneous sensibility are co-ordinated and judgments upon them formulated and identifications made. Astereognosis

is, however, usually due to an interruption of one or more of the forms of cutaneous sensation. In multiple neuritis astereognosis is common.

About two months after the onset of the numbness in his hands it passed up into the forearms and above the elbow; and, furthermore, he had a sensation as though rubber bands were drawn tightly around the elbow and around the arm above the elbow, symptoms usually meningitic in origin. These are the so-called girdle sensations, and are best known in locomotor ataxia, where they encircle the body as a tight band about the waist, or sometimes about the chest, or even around the thigh. They occur not only in locomotor ataxia, but in other spinal conditions, such as syphilitic meningomyelitis and pernicious anemia spinal cord involvement. It is a mistake to think that girdle sensations are confined to tabes. The patient had no pain, but the tight feeling continued for six months. I personally believe that these sensations are irritative phenomena, due to the choking of the posterior nerve-roots as they enter the dura on their way to the cord. Very soon the tightness also appeared across the chest. Notice the unusual location of these sensory phenomena. They are thoracic and cervical instead of lumbar in distribution. In his early illness all his symptoms were associated with his hands, arms, and thorax, indicating a lesion which must have been as high as the sixth cervical segment of the spinal cord. Sensory disturbances of the kind described in this history do not occur in multiple neuritis or in peripheral nerve disease; they occur only in spinal cord cases.

About once a week in the morning the patient soon after rising and before eating his breakfast would become nauseated and vomit a small quantity of bitter yellowish fluid. After the nausea disappeared the vomiting would cease. This nausea did not always appear, and sometimes during the day, upon taking a drink of water, the fluid would regurgitate without nausea. After taking food he was never nauseated and he never vomited. You might think that such vomiting might indicate a brain tumor, but with the distribution of the sensory disturbances and the girdle sensations we know that there is a spinal cord lesion. Fur-

thermore, the vomiting was not associated with headache, as it would be if there were an intracranial disturbance. Neither was it projectile in type.

During that time a sister, who was a trained nurse, stated that the patient was growing pale. He had had no loss of weight and his appetite was good. So he had the continuation of some disturbance of the spinal cord associated with vomiting and pallor. At the end of six months the symptoms were much lessened and the patient felt quite well during the remainder of that year, but the numbness still persisted in the hands and arms.

About September 12, 1913, the patient noticed numbness in the feet, which also had a sensation of being subjectively cold, although they felt objectively warm to the patient's hand. Such a complaint is very common in cases of locomotor ataxia. It apparently is a symptom in association with disturbance of the columns of Goll and Burdach, for when these columns are involved it is not at all uncommon to have patients complain of subjective coldness in the extremities. When you place your hand on the patient's leg it feels just as warm as it should feel, but the legs and feet seem subjectively cold to the patient. He complained that his knees also had this sensation of coldness. The numbness traveled up the legs to the thighs; it felt just as it did in the arms, and there was the same sensation as though a rubber-band was drawn tightly about parts of the lower extremities. He again had nausea and vomiting in the morning before breakfast, but never after the meal or during the day. This morning vomiting was not due to alcohol, for he is a total abstainer.

At this time he went to a physician who prescribed iron, quinin, and strychnin. He took this preparation for two months and felt better. Up to this time he had lost very little weight and has not lost much during his entire illness. The numbness still remained in the hands and feet, but was not so bad in the arms and legs. During 1913 he took iron, quinin, and strychnin most of the time and felt fairly well, but he did no heavy work. In March, 1914, the numbness again grew worse in the hands and also in the legs, arms, and thighs. The tight girdle sensations

reappeared about the thighs and in the feet. There was no nausea or vomiting and the appetite remained excellent.

Shortly after the numbness appeared in March the patient foolishly took a course of chiropractic treatments, which were of no benefit. In July, 1914, the numbness increased, weakness in the legs appeared, and the gait became unsteady. At that time there was occasional nausea and vomiting before breakfast. About the first of September, 1914, he began to lose control of the motion of his feet, and without support he would fall. At this point in his history we have excellent evidence for believing that he had some involvement of the columns of Goll and Burdach. The astereognosis, the girdle sensation, the feeling of coldness in the lower extremities, and now the presence of ataxia, unsteadiness on the feet, inability to walk over a rug, are important symptoms of such involvement. The patient states that when he realized he would fall he had no power to prevent the fall, but would either go down in a squatting position or fall limply on the hip. There was, therefore, a good deal of paraparesis as well as ataxia. Recently the legs appear stiffened at the knees, and in falling he falls sideways. Evidently there is a spastic paraparesis or beginning paraplegia.

Thus we have in the history a last element, and that is the presence of a paraplegia, a weakness in the lower extremities, and this paraplegia, as the history indicates, was a spastic paraparesis, which always means involvement of the upper motor neurons, whether in the cord or in the brain, but if it be a spastic *paraplegia* it must be due to involvement of the upper motor neurons of the spinal cord. We do not have dicerebral paraplegia coming on in an adult; such spastic paraplegia always means disturbance in the spinal cord.

The patient entered the hospital, as you will remember, on November 3, 1914, and we immediately made an examination of his blood because of the history which he gave—a typical set of spinal cord symptoms, coming on with pallor. There is no venereal history. We may at once say that the Wassermann reaction both on the blood and cerebrospinal fluid was absolutely negative.

He had on entrance 3,200,000 red corpuscles, 4800 white cells, and 70 per cent. hemoglobin. That gives a color index of 1.21; the hemoglobin should have been 58 per cent., but as a matter of fact it was 70 per cent. He looked better than he does at present so far as his facial appearance was concerned. He was ruddy and had not the slightest appearance of having an anemia of any great amount, but yet the color index was above unity. He had a characteristic change in the relative proportions of the white cells in the differential count—10 per cent. small lymphocytes, 32 per cent. large lymphocytes, 58 per cent. polymorphonuclear cells. In making a differential count of his red cells 24 per cent. were megalocytes. There were no nucleated red cells. In a typical case of primary pernicious anemia, you will remember, the color index should be above unity, there should be an increase in the lymphocytes and a decrease of the polymorphonuclears, a few normoblasts should be found, and there ought to be more than 40 per cent. of megalocytes. This picture was, therefore, that of a primary anemia, despite his ruddy color, and that diagnosis was made at that time, even though his hemoglobin was 70 per cent. and no nucleated red cells were found.

Physical examination then made showed the knee-jerks to be increased, a tendency toward ankle-clonus, present in one leg and almost absent in the other, and a bilateral Babinski toe sign, indicating involvement of both pyramidal tracts. There was also such loss of power that he could not cross one leg over the other. You will remember that he came to the hospital in a wheel-chair—he could not walk at all. He remained in bed practically all the time, getting up in the wheel-chair for only a very short time each day. Besides the very clear and definite signs of involvement of the pyramidal tracts, he also showed upon examination a pronounced ataxia of both his upper and lower extremities, slight hypesthesia in the feet and legs, and, third, a complete loss of his muscle-and-joint sense in his lower extremities. He could not tell at all which way his great toes were being moved. These three findings—the ataxia, the hypesthesia, and the loss of the muscle-and-joint sense—in themselves alone are indicative of the disturbance of the columns of Goll and Burdach. The

two sets of symptoms, motor and sensory, clearly mean that both the posterior columns and the pyramidal tracts are involved.

We may differentiate between the involvement of the cord substance and the meninges by the absence of pain, always present in meningeal involvement. But we may suspect some slight meningeal irritation because of his girdle sensations. If the disease is limited to the cord substance itself there is no pain. A locomotor ataxia case has pain not because of the involvement of the columns of Goll and Burdach, but because of the involvement of the meninges. The meningeal involvement can be determined in any case of locomotor ataxia by making a spinal puncture and testing the fluid by the Nonne-Appelt, the Noguchi, or the Ross-Jones test. The pain in tabes is due to the inflammatory condition of the meninges and the consequent choking of the roots as they pierce the dura and enter the cerebrospinal space. In other words, the pain of tabes is a sign of meningeal disturbance every time. In meningitis we know how very tender the surface of the body is. Very often the slightest touch will call forth a complaint of pain. When, therefore, you run across a case where there is no complaint of pain and where there is disturbance of motion, you know that you are dealing with a disturbance of the spinal cord instead of the meninges, and that it is the cord itself which is involved by a degenerative process. In acute anterior poliomyelitis pain is not a prominent symptom, because the disease involves essentially the gray matter of the anterior horns. Aside from the first few days there is no pain—paralysis is the dominating symptom in those cases. So in the physical examination in this case there was evidence only of involvement of the columns of Goll and Burdach and of the pyramidal tracts. The only hint of meningeal involvement was afforded by the girdle sensations.

The next step was a lumbar puncture. This had to be made for the purpose of differential diagnosis, in view of his excellent blood state. We found the cerebrospinal fluid was not under increased pressure, and that in this case the cells per cubic millimeter were of normal number. There was no positive Nonne-Appelt, Noguchi, or Wassermann test. The cerebrospinal fluid

was just as negative as it could be. This was further proof that the meninges were not involved in any discoverable amount, but that the trouble for the most part was in the cord itself.

There was no muscular atrophy; in other words, no involvement of the anterior horn-cells. Another negative finding was the absence of dissociation sensory signs. A great many cases will show preservation of the tactile sense and loss of the algesic and thermal sense. They can feel you touch them, but a pin-prick does not hurt; and if you touch them with something hot and something cold they cannot tell which is which. That leaves in this case only the involvement of the columns of Goll and Burdach and the pyramidal tracts. Whether the direct cerebellar tracts were much involved it is difficult to say. Do you recall anything in the history to indicate any possible involvement of that tract?

VISITOR: The tendency to fall to the side.

DR. MIX: Yes, that indicates a possible involvement of the cerebellar tract. The tendency toward the lateral swaying might be referred to the direct cerebellar tracts. Whether they are actually involved to any great extent in his case is doubtful, for he no longer has this tendency. The pyramidal tracts alone are usually affected. Extension to the direct cerebellar tracts is unusual.

Examination of the urine on entrance showed it to be normal. On November 4th the blood-count was repeated and the hemoglobin was estimated at 70 to 75 per cent. No nucleated red cells were found; the megalocytes were recorded on that day as 33 per cent. The count was again repeated on the 5th and showed substantially no change—3,120,000 red corpuscles and no nucleated red cells. On the 6th the red cells were counted at 2,800,000, and no nucleated red cells were found. On the 7th the count was 2,750,000 red cells, and no normoblasts were present. From the 11th to the 18th no substantial change in the red cells was recorded, and no nucleated red cells were found.

After we were perfectly certain of the diagnosis we started upon treatment with arsenic in the form of neosalvarsan. You are aware that in the treatment of any primary anemia arsenic is

the best remedy. It can be given in the form of Fowler's solution, or in the form of cacodylate of sodium, or in the form of neosalvarsan, which is to be preferred to diarsenol and other substitutes. The patient has had while he was here, between November 3, 1914, when he entered, and February 12, 1915, when he left, five intravenous injections of neosalvarsan, with improvement. For example, on December 8th his red cells numbered 3,062,000; his hemoglobin, 70 per cent. plus. On the 23d his red corpuscles were 3,254,000; his hemoglobin was 80 per cent. minus. At that time he had 41 per cent. megalocytes. On January 5, 1915, the count was 3,520,000; 24 per cent. megalocytes; hemoglobin 70 to 80 per cent. On February 10th there were 4,650,000 red cells and his hemoglobin was 70 to 80 per cent. In other words, in this last examination the picture was not that of primary anemia at all, and the count made one wonder whether he had been mistaken in previous analyses. When he left the hospital his color index was approximately .88.

Not only did he leave the hospital in excellent condition in regard to his blood, but also in regard to his spinal cord. He was able to walk with the aid of a cane and someone supporting him. He then went down to Biloxi, Mississippi, and there he continued to improve until he came north about the last of March, 1915. A few days before he left the South he was able to walk a mile with no other aid than that of a cane. He was taking no medicine at this time. He returned to Chicago, and continued to improve until June 15, 1915, when the red cells were over 5,000,000. The patient then went to his home town in Iowa, taking some sodium cacodylate with him. He continued to improve until November 15th, when he did not feel quite so well and came to Chicago to have another blood examination. He was then given cacodylate of soda in doses of 3 grains after supper each night. Once more improvement began, and he said he felt better than at any time since leaving the hospital.

Since New Year's Day, 1916, he has not been doing so well. (To Patient): How is the numbness, Mr. K.?

PATIENT: It has returned, mostly in the legs, not so much in the hands.

DR. MIX: How about your ability to use the legs?

PATIENT: They are not quite so good, but I can lift them over one another.

DR. MIX: During the period of improvement in the hospital, how much did you gain in weight?

PATIENT: I weighed 127 pounds the first time I was weighed and when I left I weighed over 145 pounds; in Biloxi I weighed 154 pounds.

DR. MIX: So he gained 27 pounds from November to March. In the last month he has lost most of this. His present weight is 143 pounds.

On April 1, 1916, the blood-count showed 3,140,000 red cells. On April 10th a differential white count showed 58 per cent. lymphocytes, 6 per cent. large mononuclear cells, 32 per cent. polymorphonuclear neutrophils, and 4 per cent. eosinophils. At this time a nucleated red cell was discovered, the first one ever found in his case. On April 20th the count was 2,620,000 red cells, 60 per cent. hemoglobin. There has not been any vomiting for about a year and a half.

When he entered the hospital early in April he had an occasional afternoon temperature. On the 6th it was 99° F. at 4 o'clock; on the 8th, 99° F. at noon, 100° F. at 4 o'clock, 99.6° F. at 6 o'clock; on the 10th it was normal all day; on the 19th he had a little fever, the first since the 14th of this month. It occasionally reaches 99° F.

Physical Examination.—The important thing is to begin with the reflexes and see whether they are increased, diminished, or lost. In his case the patellar reflex is present on both sides, but diminished. You can notice the paresis in his leg; he has to lift it up with his hand. At present the greatest amount of disturbance is in the columns of Goll and Burdach and not in the pyramidal tracts, for the knee-jerks would be increased in that case. (Testing muscle-and-joint sense.) He has some sensation of localization, but not very much. He cannot tell which way the big toe is being moved. I want you to notice this reflex (stroking sole of foot). It would seem impossible in a patient who has as much disturbance of the posterior columns as he has, and one in

whom the knee-jerks are diminished, that he should show Babinski's toe sign, yet with the slightest stroke along the outer surface of the sole of the foot the big toe goes up when normally it should go down; that is a typical Babinski toe sign. In making this test remember that the place to do your stroking is on the outer side of the sole of the foot. Sometimes you can get it by pressing in the calf of the leg; that is the so-called Gordon reflex, which he also shows. Thus this simple examination of his foot, which only takes a moment, tells us that the lateral columns—that is to say, the pyramidal tracts—are involved. We have also seen that the posterior columns are involved. If he had locomotor ataxia he would show absent knee-jerks with loss of the muscle-and-joint sense; there would be no Babinski toe sign. On the other hand, in a case of spinal cord disease, where the lateral or pyramidal tracts are involved, Babinski's toe sign is present. He has no ankle-clonus at the present time, but when he first entered the hospital in April he had enough spasticity to call forth that condition.

You might possibly suppose that he has both pernicious anemia and tabes. But upon examining the head we do not find any double vision; there is no Argyll-Robertson pupil, no facial paresis, no paresis of the territory supplied by the fifth nerve, and no disturbance of any of the cranial nerves. The orbital muscles are intact, because pernicious anemia does not affect the cranial nerves; it always affects the spinal cord alone. As we have seen, it affects the cord in one of two ways: it either produces simply a disturbance of the columns of Goll and Burdach, in which there is the sensation of numbness, the inability to tell which way the toe is being moved, the Romberg sign, which this patient has; girdle sensations about the extremities and the body, such as he has had; various paresthesias, such as he has had; tingling and numbness in both upper and lower extremities, such as he has had; in other words, a picture which is exactly like that of tabes so far as subjective signs are concerned and most of the objective signs, too. There is only one thing that these tabetic cases have which the anemic cases do not have. The true tabes has the Argyll-Robertson pupil and diplopia, whereas these patients have

no disturbance whatsoever of the cranial nerves or of the pupils. You can always distinguish between these two conditions by the examination of the cranial nerves.

Primary pernicious anemia is a toxic state, as I have said, probably an infection of some sort, and it has the peculiar faculty of attacking either the cord or the blood first. The cases in which it attacks the cord first are very numerous. If you come across an individual in whom you find these cord changes always examine the blood. I saw a physician two years ago with a hemoglobin of 80 per cent. and an excellent red count, but he had this same picture of spinal cord trouble. He proved that the diagnosis of pernicious anemia was right by developing his anemia later. I saw a patient in consultation not long ago, and she had cord changes just like those of tabes, but with normal pupillary reactions. Notwithstanding her good appearance she had the blood findings of primary anemia. In the particular case which we are now demonstrating the patient entered the hospital with a hemoglobin of 70 per cent. He looked very well, yet he presented these typical spinal cord changes, so that we were enabled by these cord changes to arrive at the diagnosis. A patient who has 3,200,000 red cells does not look half so pale as a chlorotic girl. I have a patient with pernicious anemia whose red cells number only 1,780,000, yet he is doing some work.

This patient belongs to the ataxic paraplegic type of primary pernicious anemia. The tabetic type gives only the symptomatology due to involvement of the columns of Goll and Burdach, whereas the ataxic paraplegia case gives the symptomatology of both the posterior columns and of the pyramidal tracts, as this case does. The first change noted in these cases is in the reflexes; they are absent in the tabetic type, but in the ataxic paraplegic type they are present and in most cases greatly exaggerated. Second, the Babinski toe sign is absent in the tabetic type, but is present in this type. Third, there is no paresis in the tabetic type, but in the ataxic paraplegic type there is paralysis of the lower extremities, which is of the stiff variety. Fourth, ankle-clonus never occurs in a pure case of the tabetic type, but ankle-

clonus very often occurs in a case of the ataxic paraplegic type. This man has no ankle-clonus now, but he has had it.

The symptoms of the two varieties vary in only one respect, and that is in respect to the paralysis or paresis. The underlying ataxic disturbance, the muscle-and-joint sense disturbance, occurs in both types. Notice how abruptly this man sits down. This is characteristic of the involvement of the columns of Goll and Burdach. Patients hold themselves just as long as they can when they are about to sit, and when they are almost seated they let go as soon as they are sure that they are going to sit down all right. Thus the manner in which this patient sits down aids in the diagnosis. The Romberg symptom, which he shows so well, is present in both the ataxic and paraplegic type and cannot be used in differential diagnosis. The ataxic paraplegic type agrees with the tabetic in that there is no involvement of the cranial nerves. There is no double vision, no ptosis, no disturbance of the chewing capacity. Why it is in these cases that the cranial nerves escape I cannot tell you. My clinical experience is that they always do.

Treatment.—I have already said that I believe pernicious anemia to be an infection, probably upon a spirochetic basis. Both pernicious anemia and syphilis yield to the same medication; both are apparent infections with fever, and both show a mild leukocytosis, though this man has quite a pronounced one. Hence, when salvarsan was first discovered Bramwell began to use it in these cases with excellent results. It has been widely and very effectively used. We would use it in this case now if we could get it, but we cannot at the present time. We have two substitutes, cacodylate of soda and diarsenol, which act very well. The diarsenol has been found to be reasonably effective, but not quite so effective as neosalvarsan. It is more like the old salvarsan, and is less easy to use in giving intravenous injections than neosalvarsan.

The patient is now getting cacodylate of soda, and he has taken 3-grain ampules twice a day until recently. The same necessity for changing drugs seems to exist in these cases that exists in all other cases in which infection seems to be at the

bottom. There is a tolerance established by the germs for drugs after they have been used for some time. Three or four days ago we changed from the arsenic to 1-grain doses of citrate of iron, with manganese. He will get this four times a day for several days until we can get some neosalvarsan.

This patient shows the tendency toward fluctuation which is characteristic of the disease. It lasts occasionally over a number of years, and we notice periods of spectacular improvement lasting for three or four years, while other cases seem to be steadily progressive. The type of pernicious anemia known as the aplastic type never shows any tendency to repair. There is never a time when the corpuscles will be more numerous than they were at the preceding examination, no matter what the treatment is. This case belongs to the ordinary type. His illness has lasted at least since 1912, and he is better off now than he was a year and a half ago in every way, even though he is not so well as he was in December, 1915.

It used to be thought that these cases of primary anemia rarely showed cord changes, but if you will examine them all very carefully you will find cord changes in from 60 to 80 per cent. Nearly every patient will show an inability to tell in which direction the big toe is being moved, and this means at least a mild physiologic disturbance of the columns of Goll and Burdach. Using this as evidence of cord change nearly every case of pernicious anemia will show cord involvement.

Note.—The patient remained in the hospital until July 2, 1916. He again showed marked improvement after three intravenous injections of neosalvarsan, the hemoglobin rising to 70 per cent. and the red cells to about 3,000,000. Again his cord symptoms in part abated, so that he could get about somewhat without his wheel-chair. Of course, a cure is not expected, yet his life is being surely prolonged.

Further Note, Oct. 5, 1916.—The patient was given two more injections of neosalvarsan during the summer and is now in excellent condition once more, though he can walk only with a cane. It is astonishing how effectual neosalvarsan is in his case.

CONTRIBUTION BY DR. WILLIAM ALLEN PUSEY

ST. LUKE'S HOSPITAL

SOME CASES OF ECZEMA FROM EXTERNAL IRRITATION

CASES of eczema, or of dermatitis indistinguishable from eczema, which are caused by external irritants occur with great frequency. They constitute, in fact, a very considerable part of skin diseases. They are of great interest not only because of their practical importance, but because of the innumerable and often surprising irritants which can produce them and the difficulty frequently encountered in discovering their origin. To some cases of this sort I wish to call attention here.

PRIMROSE DERMATITIS

CASE I.—Mrs. ———, age seventy-four, consulted me for an eruption occurring chiefly upon the hands and forearms. The skin was reddened and slightly swollen, with some scaling of the epidermis, and with vesicles and some weeping in patches in the centers of the areas. The eruption occurred chiefly on the dorsal surfaces of the hands and wrists, but there were patches in the bends of the elbows and behind the ears. The eruption was intensely itchy and interfered with sleep. It had existed for a few weeks, and its course showed frequent exacerbations with short intervals of partial or complete disappearance between. The patient was a portly old woman who lived in a private old people's home. She gave a history of having had an eruption about the elbows twenty years before, but no other skin trouble. She was constipated and used laxatives. She had a liberal diet, and ate freely and carelessly. She was a patient who fitted in perfectly with the conception of an eczema due to some internal disturbance. She was of full habit, a liberal eater, constipated, and led a sedentary life. The eruption, however, on the extremities strongly suggested a dermatitis due to some external chemical

irritant. The skin had a diffuse bright pink color, and a glazed surface where it was not vesicular, which differed from the stippled follicular inflammatory eruption of most eczemas, even though they are of external origin. And so an effort was made to find some chemical irritant to account for the trouble. Many of the usual sources of irritation could be excluded at once. She did no work about the house, so that her hands were not exposed to the usual domestic irritants, such as soap, sugar, antiseptics, parasiticides, cleansing fluids, and dyes. The most likely possibility seemed to be some irritating plant to which she was susceptible. I asked her if she ever worked with flowers. She said, "No," that they had plenty of flowers about the grounds, but that she never worked with them, and on pressing her she was positive that she never handled any flowers. She did not have potted plants or cut flowers in her room. She had nothing to do with flowers. I, of course, particularly suspected primroses, but she denied having anything to do with them. She was manifestly upon the defensive upon the subject of flowers, not believing that they had anything to do with her trouble, and while talking to her about primroses I finally said tauntingly to her, "Do you know what a primrose looks like?" She said, "Of course I do. I have one outside my window." "Do you ever handle that?" She said, "No; I sometimes water it, but I don't handle it." "Do you ever pick any dead leaves off it?" "Yes, I do that once in a while." "When did you do that last?" "I think it was last Saturday, and this eruption began the next day." She got well in a few days after avoiding primroses.

CASE 2.—Mrs. ———, a middle aged, spare woman, had suffered from a dry, scaly eczema on the hands at intervals for several years. She was a woman of wealth, and had been under the care of a number of famous dermatologists, both in America and Europe, and had been a great deal at European spas for her eczema. It would get well, but it would always return. She had a sluggish digestion and some muscular rheumatism, and, according to her statement, which I believe, her eczema had been invariably regarded and treated as of internal origin. I was the last dermatologist into whose hands she came for this trouble, and

I too regarded it as a straight case of eczema of the hands of internal origin. I treated her with no more success than others had done. Finally one day, after I had not seen her for several months, she came into my office and said, "Doctor, I have discovered the cause of my eczema." I asked her, "What?" She said, "Primroses." She did not know that there was such a thing as primrose dermatitis, but she found accidentally that this eruption came on after she handled primroses. She experimented then and definitely determined that the eruption was set up by primroses, and after she quit handling primroses the eczema completely disappeared.

This was a case that was much less acute than is usually seen from primroses or other plant irritation. In her the susceptibility was just sufficient to produce a very slight degree of reaction—the reaction which all of the dermatologists had regarded as a typical intoxication eczema.

The foregoing are only two rather unusual illustrations of primrose dermatitis. The cases are very common, and they are likely to escape detection because primrose dermatitis is, as a rule, much less acute than the familiar picture of poison ivy, and it is also much less generally known. When looking for local sources of eczema of the hands primroses should particularly be remembered. They are favorite house plants and many skins are irritated by them. The cases are seen more frequently during the cool months, when plant dermatitis is not expected.

ORTHOFORM DERMATITIS

CASE 3.—I was asked to see Miss ——, a middle aged spinster, on account of an acute eczema of the vulva and contiguous skin. The patient was a spare and not very vigorous woman, highly intelligent, and of nervous temperament. She had for some time been taking a rest cure for nervousness. She had had a scant leukorrhea, which had been accompanied by slight attacks of pruritus of the vulva. A week before I saw her she had developed an erythematous eruption of the external genitals accompanied by intense itching. This had increased rather rapidly until the case presented an acute vesicular eczema

of these parts. There was considerable weeping, with a discharge of the sticky serum supposedly characteristic of eczema. The condition had spread to the groins; the area around the navel was involved, and there were numerous small patches of erythematopapular eczema over the lower part of the abdomen. The urine was free from sugar. It was of high specific gravity, strongly acid, and very irritating to the affected parts. It was thought that the eczema was due to intoxication from the full feeding and lack of exercise; that these at least had intensified the original pruritus, and that scratching and the irritation of the urine and of the vaginal discharge had caused the outbreak on the genitals. There were certain facts in the case which suggested that this explanation did not cover the situation. The outbreak had come on suddenly; the picture was that of an acute vesicular eczema, and not of the subacute papular eczema that is seen from the scratching in pruritus vulvæ. The eczema of pruritus vulvæ usually shows discrete excoriated papules on a pinkish lichenified or slightly thickened skin. The eruption is rarely extensive and is distinctly subacute in character. It has remissions and exacerbations, but it is chronic. If it does develop rapidly, it does not flash almost in a night over the whole area, as the eruption in this case had done.

The character of the eruption also did not suggest the subacute dermatitis produced by the irritation of antiseptics, such as are commonly used in douches. Lysol, phenol, corrosive sublimate, in the strength used in douches, produce subacute outbreaks of dermatitis. The patient was in the hands of an expert and reliable trained nurse, and no irritating antiseptic applications—nothing stronger than boric acid and weak permanganate solution—had at any time been used. The eruption might readily have been due to iodoform or some iodine preparation, but none had been used in the case. It was found, however, that the patient had been given orthoform ointment for her pruritus, and, without suspecting it as being the cause, it had been continued in combination with a zinc ointment for the dermatitis. It was a case of orthoform dermatitis. The orthoform was removed by washing the parts with 50 per cent. alcohol, which, by the way,

is not nearly so uncomfortable in these cases as one would expect, and dilute aluminum acetate wet dressings applied. Relief was almost immediate and recovery quick.

CASE 4.—Dr. ———, a dentist, age thirty-one, consulted me for a subacute erythematous eczema of the hands. The eruption occurred chiefly on the backs of the hands and fingers. The skin was reddened, slightly scaly, with numerous patches of papulovesicular eruption and some fissures and excoriations. The condition had continued with remissions for fourteen weeks. He had previously had dermatitis from poison ivy and from metol, but no specific local irritant could be found to account for this eruption. It was thought that it was due to the irritation of antiseptics and the constant wetting of his hands necessitated by his occupation. He was six feet tall and weighed two hundred pounds and his bowels were always loose. I thought the case was one of eczema due to intestinal disturbance, and exaggerated by the irritants to which he was exposed in his occupation. I sent him to a skilful internist to rid him, if possible, of the internal factors in the case.

He was taken care of *secundum artem*, and his eczema of the hands persisted in spite of everything that could be done, whether internally or locally. He would get better and he would get worse, but he would not get well. Two years after the beginning of this experience he dropped his orthoform bottle one day and got a lot of it on his hands, and he immediately broke out with the worst attack of eczema that he had yet had. The whole thing was an orthoform dermatitis whose cause had escaped detection for over two years.

Orthoform is an exceedingly unreliable local application. It is the more tricky because it produces anesthesia. Applied to ulcers it not infrequently produces a gangrenous slough and also not infrequently it produces dermatitis. The dermatitis which it causes is exactly like that produced by iodoform. Occasionally it is subacute, as in the case of the dentist described above. More frequently it produces an acute vesicular eruption, spreading considerably beyond the area of application, and, it may be, with a generalized papular or erythematous eruption over the

body. Such accidents from it are so common that it should only be used where the indications for it are strong, and then with great caution.

PARAPHENYLENDIAMIN DERMATITIS (HAIR-DYE DERMATITIS)

The dermatitis produced by this hair dye has become so well known that there may be little use in referring to it. Cases of this hair-dye dermatitis are constantly being observed. The same sort of dermatitis also is not infrequently contracted from brown or black furs colored with this dye. The two following cases are illustrations of the condition:

CASE 5.—Miss ———, age thirty-eight, a well-nourished, healthy stenographer, came for advice for a dermatitis of two weeks' duration. The face was swollen so that the eyes were almost shut. She had a profuse macular and vesicular patchy dermatitis, extending from the hair-line both in front and back down to the neck and thorax. There was a similar eruption in the bends of the elbows. There was an erythematous dermatitis of the scalp, covered by greasy scales resembling a seborrheic dermatitis. Itching was intense and the patient felt ill.

For four or five years the patient's hair has been getting gray. Seven months ago she began dyeing the hair with a proprietary hair dye. She got a new bottle about two weeks ago. Two days after first using it the eruption began to appear on the back of the neck and forehead and grew steadily worse. When I saw her twelve days had elapsed since the last application of the dye, and the condition had become much more acute in the last three days. There was no other irritant which she had come in contact with recently. She had been at work in a clean office, and had not been exposed to poison ivy, primroses, or other plants. This case, like many of the cases of hair-dye dermatitis, improved rapidly for a few days, but after that improvement was slow. Two months after coming under observation she still had a trace of the condition without further exposure to the irritant. In this respect paraphenylenediamin dermatitis resembles formalin dermatitis. It persists as long as a trace of the irritant remains, and is apt to recur upon the slightest exposure.

CASE 6.—M. W., age thirty-six, a furrier, consulted me for a dermatitis of the hands, feet, and genitals. On the face there was a dry erythematous dermatitis. The skin on the dorsum of the hands and of the wrists showed an acute papulovesicular dermatitis. About the genitals there was an intense weeping dermatitis. The patient complained of violent itching in all the affected areas. The man had been handling dyed furs for many years, but had not developed a dermatitis until this attack. For this reason he did not suspect that origin for the condition. From the character of the eruption, the suddenness of its onset, it was regarded as due to exposure to dyed furs. Subsequent experience has proved the correctness of this. He is free from it if he does not handle furs, but the slightest contact with dyed furs starts the eruption on his hands.

These cases of dermatitis from the dye in dark furs are not infrequent. I think they occur usually from furs with long hairs and from the cheaper grades of furs, and I think also that they are possibly more frequent since the war has interfered with our supply of dyes. This cause of dermatitis is so frequent that furs should always be inquired into when patients, particularly women, suddenly develop an eczema about the neck or lower part of the face. The cases of fur dermatitis are usually slight erythematous eczemas with a good deal of itching. The cases of hair-dye dermatitis are usually cases of intense erythematous or vesicular dermatitis.

DERMATITIS FROM DEPILATORIES, DEODORANTS, AND REMEDIES FOR SUPPRESSING PERSPIRATION

With the present fashion in woman's dress, involving exposure of the armpits, there is an abundance of cases of dermatitis in these areas produced by depilatories, deodorants, or remedies for suppressing perspiration. The following case is typical:

CASE 7.—Mrs. ———, a fat woman with a fair, delicate skin, age thirty-five, came for an acute dermatitis in both armpits, the eruption extending over areas as large as two hands. It was an acute papulovesicular dermatitis, and was complicated by boils. The eruption was intensely itchy. The history was that six weeks

before she had applied under her arms a proprietary remedy for deodorizing and suppressing perspiration. A dermatitis developed within a short time and had continued up to the time that I saw her. After existing for a few weeks it had become complicated by boils. Under treatment it subsided slowly, and only disappeared after about three months' persistence.

Numerous cases of this sort, some of them without boils, could be cited. Exactly the same condition is often produced by the use of depilatories under the arms.

These cases vary in intensity, from the slightest dermatitis to intense weeping cases complicated by boils. It is not surprising that cosmetic remedies of this sort frequently produce dermatitis. The remedies for suppressing perspiration are strong solutions of irritating salts, usually aluminum chlorid and aluminum acetotartrate, and if these are used to excess or are used on very delicate skins they readily produce a dermatitis. The depilatories are nearly all mixtures of barium sulphid with inert powders. Barium sulphid is a very irritating salt which dissolves keratin, and, of course, if applied carelessly will produce a dermatitis in the toughest skin. In my opinion the application of these irritants is justified for these toilet uses, but not without knowing the possibilities of trouble which they have in them. The physician also should not forget them as possible sources of dermatitis which may be overlooked, but which, as a matter of fact, are usually discovered at the time they do their damage.

"MANGE CURE" DERMATITIS

At the present time various proprietary "mange cures" have a great popularity as remedies for scalp troubles and loss of hair. The following case is an illustration of dermatitis excited by one of these "cures":

CASE 8.—John ———, a strong, vigorous young man, whose hair was thinning rapidly, was given a "mange cure treatment" by his barber. He came to me a week later with a diffuse dermatitis over his entire scalp and spreading down over the forehead almost to the eyebrows. The scalp and skin of the forehead were bright pink, but without weeping, and the scalp was covered with

greasy scales like those of a severe seborrheic dermatitis. The skin was slightly swollen, was tender, and itched intensely. The condition was intractable. Traces of the dermatitis were still present when the patient was last seen, four weeks after coming under observation.

It is surprising that these mange cures do not produce dermatitis more frequently than they do. The chief ingredient of them is crude oil, which if applied persistently will take the hair off any skin. The other ingredient is most likely to be tar. In other words, they are the crudest sort of mixtures of irritating substances of varying composition. They do not produce irritation oftener, first, because they are such nasty applications that they must be promptly washed off, and second, the scalp is so tough that it can, as a rule, stand for a short time almost any application which is not an actual caustic.

DERMATITIS FROM PIGMENT (?)

CASE 9.—Miss X, a woman about thirty, consulted me a good many years ago for a generalized papulopustular dermatitis. The case closely resembled a fairly severe eruption of scabies. Over most of the body the patient was peppered with scratched papules and in some places there were pustules. The eruption, however, showed no furrows between the fingers. It was absent from the palms, and showed, although only to slight extent, upon the face. It had existed for two weeks. On careful examination scabies could be excluded, and it was manifestly not a case due to pediculi or other common parasites. All of the characteristics of the case, however, suggested that it was due to external irritation, and a search was made for causes of this sort. The patient had not volunteered any information in this direction and the search was rather blind. She had given her occupation as artist—a name that covers a multitude of sins—and I did not readily see how a dermatitis from turpentine, pigments, or oils could have produced the generalized papular eruption she had. I inquired further into what sort of art work she did. She said she worked in statuary, and when I inquired further she said she acted as a model, and finally, after considerable effort, I elicited

the fact that her "art work" consisted in posing for living pictures (it was at the time that that sort of indecency was popular), and she was a sort of an artist who covered herself all over with gilt paint and made a gilded statue of herself. Her dermatitis was due to her painting her body all over in this way. Whether it was excited by the paint or the bronze in which it was suspended, or whether it was due to the irritation in getting the bronze off, which she said was difficult to do, I am not certain. The irritant in this case might very well have been the bronze pigment, for dermatitis is not uncommonly excited by the pigments used in paints. I recall one experience where cases of dermatitis came into the Cook County Hospital with such frequency from one paint manufacturing plant that we called attention of the Health Department to the situation, in order to force a change in working conditions so that the patients would not be exposed so much to the irritation of the dust of the pigments.

As indicated by the cases above, these conditions may be obviously of external origin, or their relation to external causes may be very difficult to determine. Sometimes they are acute dermatitides, which are so intense or so sharply circumscribed that they do not fall in with our clinical conception of eczema. In other cases they are quite indistinguishable from our classical pictures of eczema; so indistinguishable that expert dermatologists may be completely deceived by them. These cases of eczema or eczema-like dermatitis produced by external irritants are excessively common. They are so common that, as a dermatologist's experience increases, I think the importance which he places upon external causes of eczema gradually increases. A few years ago Knowles, in a careful study of over 4000 cases of eczema, found that over one-fourth were of definitely ascertainable local origin. In the discussion of Knowles' paper it was objected that the cases which he had called eczema due to external irritants were dermatitis, and were not eczema. The fact remains, however, that expert dermatologists often cannot distinguish these cases from eczema. They are identical in their clinical and histologic manifestations with eczema, and when we maintain that they should not be called eczema simply because we

know their local origin we are reduced to the logical absurdity of holding the position that things which are the same are different.

Often certain features in the cases suggest their local origin. The eruption may be more sharply localized—it may have a sharper border than the usual gradually fading border of eczema; the surface may present a glazed pinkish hue—a ground-glass hue and a diffuse color which is suggestive. The eruption may be of more intense degree than we see in eczema. These eruptions occur at the sites of contact with irritants and are likely to be more intense at these sites. They are seen on the scalp or under the arms when applications are made to these locations. When they occur from accidental contact they commonly affect the face or hands. But they are not confined to these sites, and the physician should not be misled by the fact that the eruption occurs in places little likely to come in contact with an irritant, for these eruptions frequently develop far away from the site of contact with the irritant. This is a phenomenon seen in many forms of eczema; the source of the trouble exists at only one or a few points, but eczema develops widely. Many times, on the other hand, the features which suggest local origin are entirely lacking, and the cases present pictures in no respect different from those of ordinary eczema.

The physician also should not be misled by the patient's statement that he has used this or that local application for a long time without producing irritation. It constantly happens that a local irritant may be used with impunity for years without ill effects, and finally increased sensibility to this particular irritant develops and the patient's skin can no longer tolerate it. This is a common observation in occupational eczemas. One sees barkeepers, laundry women, soda-fountain men, plasterers and other workers in lime, painters, and workers in irritating oils and in gasoline who develop an intolerance to an agent which hitherto they have handled without injury. The most notable irritant of this sort is formalin. It is a common characteristic of formalin dermatitis that it is a manifestation of acquired susceptibility. A laboratory worker or surgeon who thinks himself immune to irritation from formalin in ordinary strengths will

suddenly find a dermatitis from it, and after that he cannot bear in comfort exposure to the slightest trace of its vapor.

TREATMENT

The prospect of cure in these cases, of course, depends largely on ridding the patient of the cause of irritation. This may be a very simple matter or it may be a very difficult one in practice. If it is an irritation that comes in the course of one's occupation the problem is greatly complicated. Sometimes the only solution is change of occupation. This to a man in a skilled occupation may be a great hardship. Sometimes the irritation is so severe and so intractable that this hardship cannot be avoided. Sometimes it can be in large part overcome by treatment. For example, I know the case of a plasterer, a man who can make six dollars a day the year round at his trade, who developed a hypersensitiveness to lime, and suffered from such a dermatitis of the hands and forearms that he was reduced to poverty from inability to work. He was cleared up by wet dressings of aluminum acetate solution, and he is able by the habitual application nightly of aluminum acetate dressings to pursue in comfort and without interruption his occupation.

The stopping of the irritating application is not always followed by prompt relief in these cases. A good illustration of this is seen in hair-dye dermatitis, which frequently persists for weeks after the dye has been applied. This is chiefly due to the persistence of the irritating chemical in the skin. But not infrequently the shock to the skin caused by the original outbreak of dermatitis, if it is severe, seems to leave a hypersensitive skin; to establish a bad habit in the skin, as it were, so that eczema persists or breaks out in the future under slight provocation. As a rule, however, the removal of the irritant is followed by the rapid disappearance of the dermatitis in these cases.

The first essential of treatment, of course, is to get rid of the irritant. The plant irritants, like those of primrose and poison ivy, whether they are one substance or not, seem all to be soluble in alcohol, and washing with dilute alcohol is the first step toward prompt relief. Dilute alcohol (50 per cent.) is sufficient and is

not very irritating. Paraphenyldiamin also is soluble in alcohol, and cases due to it are improved by washing in dilute alcohol. Indeed, I think in most of these cases it is a safe procedure to wash them in alcohol. If the irritant is one, like zinc chlorid or aluminum chlorid or acetotartrate, soluble in water, washing in water is sufficient. After this the most universally soothing and useful application is wet dressings of aluminum acetate solution; about 1 part of an 8 per cent. aluminum acetate solution with 15 parts of water. This is not only soothing but hastens recovery.

Greasy applications are apt to be irritating. They are usually not comfortable unless the irritant has been gotten rid of by washing with alcohol or by some other means, for they cause a retention upon the surface of the irritating substance. After wet dressings or lotions have been used for a while and the reaction has in any part subsided, bland ointments furnish the lubrication of the skin and the slight protection that carries the cases along to complete relief.

CLINIC OF DR. FREDERICK TICE

COOK COUNTY HOSPITAL

A CASE PRESENTING ADDISON'S SYNDROME

Consideration of Various Conditions Capable of Producing Pigmentation of the Skin. Three Cardinal Symptoms of Addison's Disease: Physical and Mental Inertia, Gastro-intestinal Disturbance, and Pigmentation. Theories as to the Production of Addison's Disease. Pathologic Changes Found in the Suprarenal Capsules. Importance of the Chromaffin System. Prognosis and Therapy.

Present History.—This patient entered the hospital on April 17th with this history: She was in this hospital about twenty months ago. In 1911 she had a Cesarean section. While convalescent from this she contracted typhoid, which lasted for nine weeks. Two weeks after leaving the hospital brownish discolorations began to appear on her face and she continuously felt weak and nervous. There were no gastro-intestinal or cardiac disturbances at that time. She remained in the same condition until two years ago, when she observed that a brownish pigmentation appeared on her gums and there was a slight increase of the generalized pigmentation of the skin. In July, 1914, she began to have intermittent attacks of nausea and vomiting unaccompanied by diarrhea. The attacks varied with the type of food eaten, coarse food bringing on the nausea and vomiting. At this time cardiac palpitation and a weak, rapid pulse were also present.

When she left the hospital twenty months ago her color was good, she felt strong, and the gastro-intestinal symptoms were practically absent. For the next fourteen months she felt comparatively well and was able to do housework. Her color was

good except just before each menstruation, when the pigmentation was relatively increased. Six months ago the joints of the left arm became painful and swollen. This was followed in two weeks by an acute attack of appendicitis. The pigmentation was very much increased and severe vomiting persisted for two weeks. Since then she has been able to be up and about, but is very weak, particularly on the least exertion. She also suffers from palpitation of the heart, and is practically limited to a liquid diet.

The History as Recorded when She was in the Hospital Previously.—She entered the hospital on July 22, 1914, and remained under observation until August 22d. Her complaint then consisted chiefly of the dark brownish, pigmented areas which appeared first on the forehead. These areas disappeared, but returned in a short time, and persisted up to the time that she entered the hospital. Two months previously the skin over the entire body became dark brown in color, and this gradually increased in intensity. She had no other symptoms except a slight sensation of fatigue. She felt sleepy most of the time and was very nervous.

Personal History.—The patient is married; her husband is living and well. One child is living and well; she has had no miscarriages. Father, mother, brothers, and sisters are all well. Venereal history is denied; there is no history of the use of alcohol.

Physical Examination.—The history refers to discoloration of the skin, and we will direct our attention first to this complaint. Inspection of the face reveals a diffuse increase in the pigment of the skin. Five years ago she was as white as the ordinary individual. Aside from this diffuse pigmentation involving the skin of the face and neck, we also find that the pigment is irregularly distributed. Over the forehead, about the face, and on the neck the pigment is collected in areas or spots, so that there is, aside from the universal pigmentation, an irregular, blotchy condition. The pigmentation is most intense over the exposed surfaces of the body from the clavicles upward, on the hands, especially the fingers, and in the region of the neck. Over the scapulæ and the acromion processes on either side it is more pronounced than over the lumbar region.

Examination of the lower extremities reveals the same condition, but perhaps not so pronounced. There is an increased pigmentation of the entire surface of the body, including the legs, and it is particularly increased over the anterior surface of the knees, but is not so marked in the popliteal region. The toes present the same appearance as the fingers.

Conditions Producing Pigmentation of the Skin.—From the clinical standpoint we have as one of the chief manifestations in this case the increase in the pigmentation of the skin, a so-called *melanoderma*. Perhaps it is well to consider some of the conditions capable of producing an increase in the pigmentation of the skin. In doing so it will be necessary to take into consideration the fact that the pigmentation of the skin varies physiologically. In certain individuals a marked increase occurs which must be looked upon as perfectly normal. This occurs in certain races and also in certain climates. A person in a tropical climate with a relative increase in the pigment is considered normal, but on moving to a northern climate he is looked upon as abnormal. This also occurs in certain families; certain members will be dark and have a relative increase in the pigmentation, which is merely a physiologic variation.

This patient, up to four and one-half or five years ago, was as white as the normal individual, and the discoloration first appeared on the forehead, and has gradually increased since that time. There are many pathologic conditions which may be associated with pigmentation. Perhaps first of all to be mentioned, because a pigmentation of the skin suggests it, is *Addison's disease*. To discuss the symptom-complex of Addison's disease with any satisfaction it would be necessary to decide first of all upon the definition of the disease. What is understood by Addison's disease? Is it a symptom-complex regardless of the condition of the suprarenals, or is the initial lesion to be restricted to a tuberculosis of the suprarenal glands with or without the symptom-complex? Or is Addison's disease due to something aside from tuberculosis—to a fibrosis, a malignancy, a gumma, or a hemorrhage into the suprarenal capsule? Of this we will have more to say later. At this time it is sufficient to mention Addison's disease as one

of the conditions to be considered in connection with a melanoderma.

Second, in *leukemia*, either the splenomyelogenous or the pseudoleukemic type, pigmentation of the skin is not infrequent as a result of the leukemia or pseudoleukemia, or in some instances as a result of the medication.

Third, in *tuberculosis*—pulmonary, peritoneal, or glandular—a pigmentation may occur.

Fourth, in *malignancy*—in carcinoma, in sarcoma, and particularly in retroperitoneal sarcomas—there is not infrequently a cutaneous pigmentation.

Fifth, in *aneurysm*, more particularly of the abdominal type, there may be a discoloration.

Sixth, in *pancreatic disease*, in diabetes, the skin may become very much pigmented, and this condition is usually associated with a hypertrophic condition of the liver.

Seventh, in *exophthalmic goiter* cutaneous manifestations are relatively frequent, and perhaps as frequent as any is the disturbance in the pigmentation.

Eighth, the administration of certain *drugs*, more particularly of arsenic in the form of Fowler's solution, eventually will produce increased pigmentation, as in the treatment of anemias, leukemias, and various cutaneous diseases.

A similar condition may occur with the administration of silver salts. In chronic gastritis, in ulceration of the stomach, and in the treatment of epilepsy where silver nitrate formerly was used the long-continued use of the drug produced a pronounced pigmentation of the skin.

Ninth, in *pellagra*, not infrequently, there is a pigmentation of the hands, the arms, and face, particularly after the subsidence of the acute attack and when the chronic stage develops.

Tenth, certain *pelvic conditions* are capable of producing pigmentation. We are all familiar with the pigmented spots which appear upon the face during normal pregnancy. With ovarian and uterine tumors there may be a very definite pigmentation, which may entirely disappear after removal of the tumor. There was a patient here in the hospital some seven or eight years ago

who had clinically an Addison's syndrome. She was also suffering from a large ovarian cyst. The tumor was removed, and with its removal the pigmentation entirely disappeared. In another patient the clinical diagnosis of Addison's disease was made on the basis of the pigmentation, the gastro-intestinal symptoms, the weakness, and the pronounced secondary anemia, and upon investigation it was found that the patient had received Fowler's solution over a number of weeks. But this was eliminated as an etiologic factor for the reason that after the discontinuance of the arsenic the pigmentation still continued and even increased. That patient suffered from some genito-urinary disturbance and finally died. On postmortem the adrenals were found to be absolutely normal, but there was an abscess of the prostate gland, a cystitis, and a bilateral pyelitis.

There are other conditions, but these will answer the purpose to illustrate how numerous and diversified are the conditions capable of producing a pigmentation of the skin.

Cardinal Symptoms of Addison's Disease.—In considering more in detail the symptom-complex designated as Addison's disease it will be found that the clinical condition is characterized by three cardinal symptoms. First to appear is usually the physical and mental inertia. The patient has been perfectly well, but for some unexplained reason there is a gradually increasing weakness. The patient becomes unable to perform his usual work, tires easily, is mentally depressed, perhaps there is loss of memory, forgetfulness, and along with this condition there is a change in the character of the heart action and pulse-rate. The pulse gradually increases in rate, becomes soft and compressible, and the blood-pressure is found to be below normal.

Following this there will usually appear the second symptom, and that is gastro-intestinal disturbance. There is, first of all, loss of appetite. The patient has no desire for food. If food is taken there is nausea and vomiting, and frequently severe pains referred to the lumbar region. At first constipation is present, but later diarrhea appears, perhaps alternating with attacks of constipation. The diarrhea in the last stages of the condition becomes very marked.

Then the third cardinal symptom is the pigmentation. This appears and increases gradually. It involves practically the entire external surface of the body as a rule, but it may be limited. It is more marked over the exposed surfaces of the body, the face, neck, and hands, and also about the waist in the line of constriction from the waistband and in the genital region. The mucous membranes may also become involved, and from a clinical standpoint this is rather highly suggestive and important, especially if the mucous membrane of the mouth is affected. The increased pigmentation appears along the borders of the gums, as is present in this case. The pigment is distributed over the entire buccal surface of the cheeks, especially in a linear manner, continuous with the fissure of the mouth, and running parallel to the edge of the teeth. In this patient there are areas of pigmentation on the buccal surface, rather small but fairly definite. This rarely occurs under normal conditions. The mucous membrane of the eyes is only occasionally involved. Perhaps more frequently the mucous membrane of the vagina becomes pigmented.

The three cardinal signs, then, in the diagnosis of Addison's disease consist of, first, the physical and mental inertia, the inability to think or work; second, the gastro-intestinal disturbance; third, the pigmentation. Any one of these three may be absent. The gastro-intestinal disturbance may be entirely wanting, with the weakness and pigmentation present. Or the weakness may be so slight as to be practically absent, with the gastro-intestinal disturbance and the pigmentation present. And still more difficult is the task of making a diagnosis of Addison's disease when the pigmentation is absent. This, however, does occur and is analogous to what may occur in exophthalmic goiter. Any one of the four symptoms may be absent in that disease, but we do not hesitate to make a diagnosis. An analogous condition also occurs in scarlet fever. It is admitted that we may have a scarlet fever without the rash.

Further examination of the patient reveals a pulse-rate ranging from 80 to 90. The temperature has been normal and the respirations 18 to 20 per minute. The auscultatory systolic

blood-pressure is 100, diastolic 70. The blood examination—the white count only is recorded—reveals 9200 leukocytes. The differential count is normal. In some of the reported cases of Addison's disease there is a relative increase in the lymphocytes.

There is no increase in the size of the thyroid. The findings in reference to the heart are normal. The dulness is not increased, no murmurs are heard, and the only possibly abnormal finding is a decrease in the force of the heart beat. The pulmonary examination reveals on auscultation a few fine crackling râles over the right apex. Percussion resonance and tactile fremitus are both normal.

The abdominal examination reveals a scar which is the result of the Cesarean section. There is no distention of the abdomen. On palpation there is perhaps a slight increase in the rigidity of the abdominal muscles, and the patient complains of tenderness in the ileocecal region. Only slight pressure over McBurney's point causes discomfort. No tumor mass can be palpated. The liver and the spleen are not palpable. The lower pole of the right kidney is palpable. A pelvic examination reveals an increased resistance and an indefinite mass on either side. At the time of her Cesarean section she was informed that she had cystic ovaries.

Pathogenesis.—Reference has been made to the involvement of the suprarenals in the production of Addison's disease. There are two theories as to the production of Addison's disease. One is concerned with the suprarenal capsule and the other with the sympathetic system. Perhaps a third might be added, to the effect that the suprarenal and sympathetic system are both involved. In the series of cases collected by Lewin the suprarenals were found to be normal in 12 per cent., diseased in 88 per cent. Studied from another standpoint, the frequency with which the suprarenals may become involved without the clinical manifestations of Addison's disease, it was found that disease of the suprarenals occurred without pigmentation in 28 per cent.; that is, in more than one-fourth of the cases the skin did not become pigmented, but the suprarenals were involved. There were clinical manifestations of Addison's disease in 72 per cent. Of the

various conditions studied, tuberculosis of the suprarenals is admitted to be the most frequent cause of Addison's disease. In a little more than 50 per cent. of cases of Addison's disease due to tuberculosis of the suprarenals, tuberculosis was also found in some other portion of the body; that is, pulmonary, osseous, glandular, or peritoneal tuberculosis. Other pathologic changes found in the suprarenals in cases of Addison's disease are malignant tumors, carcinoma, or sarcoma; second, adenoma; third, syphilis, particularly gumma of the suprarenals; fourth, echinococcus; fifth, hematoma or hemorrhages into the suprarenals; sixth, chronic interstitial changes in the suprarenals; seventh, a condition of hypoplasia or complete absence of the suprarenal glands; and, eighth, particularly described by Virchow, acute hemorrhagic conditions of the suprarenals.

When all the conditions capable of causing pigmentation of the skin are considered, some of them not involving the suprarenals, and according to the reports that the suprarenals may be involved without producing any pigmentation, or a tuberculosis of the suprarenals without a pigmentation, what is one to conclude? It would seem that our conception of Addison's disease must necessarily depend upon our definition. If we were to limit the symptom-complex to tuberculosis only of the suprarenals and exclude all other conditions, then we must have etiologically a tuberculosis of the suprarenals. But, as previously stated, in many cases of tuberculosis of the suprarenals the pigmentation does not necessarily occur. Why does the pigmentation take place? What is the pathogenesis of the pigmentation? Why do we have in carcinoma of the pancreas or other abdominal organs, or tuberculous peritonitis, or aneurysm, particularly of the abdominal aorta, or in ovarian or uterine tumors with or without a suprarenal involvement, a pigmentation of the skin? The suprarenal capsule histologically contains a cortical and medullary portion. The medullary portion is concerned in the production of the internal secretion usually designated as suprarenalin, and its particular function is concerned with the neuromuscular tonus, producing an increase in the blood-pressure and a tonicity of the muscles in general. Its second function is con-

cerned in some way with the pigmentation. The cortical portion is concerned more particularly with the sexual function; this portion becomes increased during pregnancy. In the medullary portion of the suprarenal capsules there is connective tissue, a large number of cells, and nerve-fibers. Perhaps the most important cell is the so-called *chromaffin cell*. This is found in the medullary portion, also outside the cortical portion of the suprarenal capsule, in the sympathetic ganglia, in the substance of the carotid glands, and in the epididymis, and all these cells go to make up what is known as the *chromaffin system*. Presumably the chromaffin system is associated with the production of the pigment of the skin. If this is true, one can understand how in pulmonary tuberculosis and in abdominal involvements, although the suprarenal capsule remains absolutely normal, a disturbance of the sympathetic system outside the suprarenal capsule is sufficient to produce the pigmentation. That is perhaps why in pregnancy and in exophthalmic goiter this same condition occurs, due not to suprarenal involvement, but to chromaffin disturbance.

Where an Addison's syndrome occurs clinically, as occurred in the case cited with the ovarian cyst, and the patient in whom normal suprarenals were found at autopsy, then we can account for the pigmentation on the basis of a disturbance of the chromaffin system outside of the suprarenal bodies.

As to the **diagnosis** in this patient, we can make a clinical diagnosis of Addison's disease or, better, Addison's syndrome and an appendicitis. By designating the condition as *Addison's syndrome* we are not compelled to indicate our conception of what is present in the suprarenal capsules.

The **prognosis** is invariably bad. The course will vary according to the type of the disease. It sometimes runs its course in a few weeks, and this is particularly true in the young. In one patient under observation the onset, entire course, and fatal termination took place within three weeks. Usually it is a matter of months, sometimes a few years, with exacerbations, the patient improving for a while, then becoming worse, with the gastrointestinal disturbance becoming more and more pronounced.

The **treatment** depends upon the etiology. Some cases are amenable to surgical treatment—ovarian tumors, uterine tumors, and possibly some of the other conditions may be relieved surgically. Not many can be relieved medically. Probably the best prognosis is in a luetic infection with a symptom-complex of this type. In such cases the antispecific treatment will often prove beneficial. If the condition is due to suprarenal involvement, most frequently there is a bilateral, progressively destructive lesion, and little or nothing can be done. If, as has occurred, an operation is undertaken and a kidney with the involved suprarenal removed, recovery may be expected if the involvement is unilateral. But where the process is bilateral, surgical interference will be of no assistance. One might expect to obtain results by the administration of suprarenal extract. This patient, when under observation in the hospital previously, received adrenalin, 1 c.c. three times a day, with the result that she improved very materially. The pulse, which was 100 to 120, soft and compressible, with a low blood-pressure, improved, so that when she left the hospital the pulse-rate was 80 with an increase in force; her weakness had materially improved and the gastrointestinal disturbance had entirely disappeared. Usually, however, the administration of suprarenal extract is followed by only temporary improvement. This has been the experience when it was given by mouth, subcutaneously, or intravenously. It certainly has no permanent benefit.

Subsequent Note.—Since presenting this patient in the clinic, there was an exacerbation of the appendicitis, and she was transferred to the Surgical Service. A laparotomy was done May 15th, the abdomen thoroughly explored, and an old adherent appendix removed. So far as could be determined no other pathology was present. Death occurred the day following the operation. Permission for an autopsy could not be obtained.

GANGRENE OF THE LUNG: WITH SPECIAL REFERENCE TO TREATMENT

Etiology and Differential Diagnosis of Pulmonary Gangrene.
Localized Physical Findings in the Right Lower Lobe. Ex-
pectoration of Purulent Material and Offensive Odor of the
Breath Valuable Diagnostic Points. Three Indications in the
Treatment.

March 27, 1916.

Present History.—This patient, twenty years old, a factory worker, entered the hospital March 12th. Four weeks ago the patient was taken sick suddenly with a severe chill, which lasted about twenty minutes. She felt quite ill, but went to work that day. The following day she had a severe pain in the side and began to cough. She has been in bed ever since. She has been coughing and has had more or less pain in the side. Four days ago she began to cough up bright red blood and has also vomited blood. Since then the hemorrhages have continued almost daily. This morning she had a chill which lasted twenty minutes. During the four weeks she has always felt more or less feverish and now has considerable pain in the right side, especially on coughing.

The *physical findings* at the time she entered the hospital were as follows: General inspection revealed a young Italian woman suffering with a severe cough and dyspnea, and spitting up considerable quantities of bright red blood. Examination of the head was negative. There was no herpes on the lips, the throat was hyperemic. The neck showed a slight adenopathy, no pulsation; the thyroid was not enlarged.

Examination of the chest showed diminished respiratory expansion, especially on the right side. The breath sounds were almost tubular over all of the right chest posteriorly excepting at the base. Over the left lung posteriorly there was bronchovesicular breathing. Coarse and fine râles were heard

throughout both lungs. Resonance was slightly impaired over both lungs posteriorly. It was fairly good over the upper lobes anteriorly.

The cardiac examination was negative. The pulse was regular and of good quality.

The abdomen showed no irregularity, no peristaltic waves, and the liver and spleen were not palpable. The extremities were negative.

The temperature chart revealed the presence of a constant pyrexia. The temperature was 102.2° F. when she entered the hospital. The following day the temperature fell to 99.2° F., but subsequently rose on the fourth day of her stay to 103.3° F. It has continued above normal, a rather irregular temperature, showing a definite tendency toward an afternoon elevation. The pulse has ranged from 108 to 134; the respirations have averaged from 30 to 34.

There are notes on the history to the effect that she complains of much pain on her right side and that she has been expectorating blood. Nose-bleed has also occurred. On the second day of her stay here she expectorated and also vomited blood, and in the afternoon of that day there was another attack of vomiting which consisted chiefly of blood. Since then she has vomited blood at least once a day up to two days ago.

Physical Examination.—During these coughing attacks the difference in expansion of the two sides of the chest with the patient in the dorsal position is apparent. With the back resting flat upon the table there is a definite difference in the two sides. The left side is larger than the right, and during the ordinary respiratory efforts the expansion is better on the left. This is particularly true when she takes a deep breath—there is lagging of the right side while the left side expands. Litten's sign is present on the left, but absent on the right. The apex-beat is rather diffuse, and, as far as we can determine, it is in the fifth intercostal space.

On percussion there is good resonance down to the splenic border on the left. On the right side there is impaired resonance above the clavicle. Immediately beneath the clavicle the per-

cussion resonance improves and is about equal to that of the left. The upper border of the liver is at the fifth rib. The right border of the heart is at the midsternal line, the base at the lower border of the third rib, and the left border practically in the midclavicular line.

In the upright position, with ordinary breathing the right chest posteriorly is a little smaller and the scapula a little more prominent. On percussion posteriorly over the entire left side there is good resonance from apex to base. On the right side, in the suprascapular region, there is slight impairment of percussion. On a level with the scapular spine there is dulness which becomes definitely flat as we percuss downward. There is also a marked sense of resistance. Over this area of dulness tactile fremitus is increased, but is almost absent over the area of flatness.

On auscultation there is tubular breathing over the area of dulness, but the breath sounds are indistinct over the area of flatness.

This patient's temperature this morning is 100.2° F. Since March 18th she has been coughing and expectorating a purulent, foul-smelling material. The sputum cup is about half full, which is the greater part of what she has expectorated during the last twenty-four hours. She expectorates most in the morning; later in the day the amount is smaller. As you will recall, there are some definite findings on the right side of her chest, more particularly posteriorly. Over the right side of her chest there is impaired resonance, which corresponds with the area of the right lower lobe. Impaired resonance over the apex is only relative. On palpation, tactile fremitus is increased over the upper portion, while over the lower portion it is almost absent. On auscultation over the upper portion there is tubular breathing associated with large moist râles. Over the lower portion the breath sounds are distant. Over the upper portion bronchophony is present, but it is absent below.

Differential Diagnosis.—With these findings and the history, particularly the daily hemorrhages, the suspicion of a *pulmonary tuberculosis* was aroused. It was on account of this suspicion

that her sputum was examined carefully. Repeated examinations with the antiformin and other methods have failed to show tubercle bacilli. One of the considerations that made the existence of a pulmonary tuberculosis doubtful was the location of the physical signs, the right lower lobe being involved, the remaining portion of the lung practically uninvolved. A primary pulmonary tuberculosis involving a lower lobe is not very frequent. It is estimated that a primary lower lobe involvement occurs only about once out of 500 times.

Another possible diagnosis was considered because of the history that four weeks before her entrance she was taken sick suddenly with a severe chill, and the following day she had a severe pain in the side and began to cough. Was this the onset of a *lobar pneumonia*? That diagnosis was made in the receiving ward, and she was treated for a pneumonia by her family physician for a month before she entered the hospital. Was it lobar pneumonia or was it pleurisy? Did she have a fibrinous or serofibrinous, or possibly a purulent pleurisy instead of a pneumonia? Some of the findings are strongly suggestive of a pleural involvement—the flatness in the lower portion of the chest, the absent tactile fremitus, and the distant breath sounds over the right lower lobe. The irregular temperature and the leukocyte count of 19,800 also suggest the possibility of an empyema.

But one of the strong arguments against the presence of fluid in the chest is the lack of displacement of the neighboring organs. The heart is not displaced, the liver is not displaced downward, and there is no shifting of dulness on change of posture. A diagnosis of fluid in the chest is impossible unless it is assumed that the amount of fluid is small or encysted.

Another possible diagnosis, which was one of the early considerations, was an *unresolved pneumonia*, assuming that the patient actually did have a lobar pneumonia, and that instead of the crisis occurring there was a delayed resolution. The findings, particularly during the first few days of her stay in the hospital, rather strongly suggested a delayed resolution.

Another possibility, mentioned by one of the clinicians, was an interlobar empyema; that is, a collection of purulent fluid in

one of the lobar fissures, but the outline of the dulness corresponds too accurately with the outline of the lower lobe, and this was not seriously considered. A *pulmonary abscess* seemed more likely than an interlobar empyema.

To assist in the diagnosis several exploratory punctures at various points were made, but all were negative.

On March 18th the patient instead of expectorating blood, for the first time expectorated this foul-smelling, viscid material. The occurrence of the foul-smelling sputum and breath at once aroused the suspicion of a *pulmonary gangrene*. It is usually upon the character of the sputum and the foul, extremely offensive odor of the breath that the diagnosis of a pulmonary gangrene depends. There is probably no question that this condition existed, and had existed during the entire time since she entered the hospital, but it had passed unrecognized. With the occurrence of the foul sputum and breath it was easy to account for the other symptoms. Pulmonary hemorrhages are frequent in gangrene. They may be small and limited, due to a hyperemia, or, not infrequently, they are large and profuse, exactly like the ones that occur in a pulmonary tuberculosis. They are due to the gangrenous destruction. The temperature, the leukocytosis, and the physical signs all became very clear as soon as the patient expectorated this foul-smelling material.

In this connection you will recall the patient presented a few weeks ago with a pulmonary gangrene. By means of the puncture the same kind of material was obtained that she was expectorating, and after the puncture there was quite a definite, localized swelling and some subcutaneous emphysema following. That patient was transferred to the surgical ward and drainage instituted, but with a fatal outcome.

Etiology.—Pulmonary gangrene is due to a putrefactive process. It is essential that at least two conditions be present for the production of a pulmonary gangrene. First, there must be an interference with the normal nutrition of the lung, and, second, there must be present putrefactive elements or various types of saprophytes. One is constantly inhaling various types of putrefactive elements which under normal conditions of the

lungs do not produce gangrene, but under abnormal conditions, where resistance is lowered, gangrene may occur. The predisposing factor may be present in the bronchi. In a putrid bronchitis, or bronchiectasis, from the decomposition and putrefactive material in the bronchi, and particularly from the aspiration of this material into the lungs, a septic pneumonia results, and not infrequently a gangrene. An *aspiration pneumonia* is a common cause for a pulmonary gangrene. This occurs most frequently in paralytic conditions, in the insane, and where mechanical feeding is necessary. The introduction of a small quantity of food into the bronchi frequently results in a pulmonary involvement and then a gangrene. In the aspiration of infectious materials from the upper sinuses it is relatively frequent that the final termination is by pulmonary gangrene.

A second group of causes includes the pulmonary diseases, of which a *bronchopneumonia* is relatively frequent, particularly a bronchopneumonia of septic origin, where the pneumonia results from the aspiration of some septic material from the upper respiratory tract. In *croupous pneumonia* it sometimes occurs, but less frequently. In *tuberculosis of the lung* a gangrene occasionally occurs, but it is surprising how infrequently it is found. Even with an extensive tubercular involvement gangrene is infrequent. Occasionally the production of a septic embolus in puerperal fever, or a septic thrombus from which a septic embolus becomes detached, may produce a septic pulmonary infarct, and this goes on to the production of a gangrene.

Third, *trauma* to the chest, stab and gunshot wounds are rather frequently associated with a pulmonary gangrene.

A fourth group includes *mediastinal tumors*, the carcinomas, sarcomas, and aneurysms. These usually produce a gangrene by compression of the bronchus or the lung. In carcinoma of the esophagus, when perforation occurs, gangrene is a relatively frequent result.

A fifth group includes the *pleural diseases*, particularly the empyemas, where, by compression of the lung or by actual rupture of the empyema into the bronchus, the gangrene occurs as a complication.

Sixth, *abdominal diseases*, such as a subdiaphragmatic abscess, an hepatic abscess, a carcinoma or ulcer of the stomach, by perforation of the diaphragm and extension, may lead to pulmonary gangrene.

Seventh, the ear surgeons report pulmonary gangrene with surprising frequency in thrombosis of the lateral sinuses, in mastoiditis, and in septic embolism. In fat embolism, particularly following a local infection in compound fractures, the same condition has been found.

Gangrene of the lung is usually of the moist variety, which may be localized in area, where there is a definite limiting wall, or diffuse where an entire lung or a great portion of a lung is involved.

The **prognosis** formerly was looked upon as very unfavorable, but in the majority of cases of localized gangrene recovery eventually takes place under proper treatment. In the more extensive or diffuse variety the prognosis is not good. With the assistance of surgery the outlook is much more favorable.

Treatment.—The indication in the treatment is threefold: First of all, and one of the important items in every case of gangrene, is the effort to increase the resistance of the patient not only by hygienic and dietetic measures, but also by medicinal treatment. These patients should have an abundance of fresh air and sunshine, an abundance of good food, and a good tonic. They ordinarily receive elixir of iron, quinin, and strychnin. Frequently they receive iron and arsenic hypodermically, and this is particularly true if there is the least amount of gastric disturbance.

A second indication is to relieve the patient, as well as those in the immediate vicinity, of the offensive odor from the sputum and the breath. Many methods have been employed to accomplish this object. Traube suggested and used inhalations of turpentine and hot water. Creosote and phenol have also been used. The method which is employed in the Brompton Hospital in London in these cases, as well as those of bronchiectasis, is the so-called creosote bath. The patient is placed in a suitable room and the creosote is evaporated over the flame, the

patient inhaling the fumes. Before entering the room the patient is prepared by placing a cold compress over the eyes. At first the inhalation of the creosote fumes is irritating, and usually induces a marked increase in the expectoration, but with a definite decrease of the offensive odor. Combined with the inhalation of the creosote it is quite customary to administer creosote or guaiacol internally. More recently it has been the custom to treat the gangrene by direct injection. Iodoform emulsion, or phenol, or guaiacol have been injected directly into the parenchyma of the lung. Intratracheal injections or irrigations are favored by some.

A third indication in the treatment is to improve the amount of drainage, particularly in the presence of a cavity, by surgical interference. A cavity usually results because of the gangrenous process, and when this condition exists, particularly if it can be located with any accuracy, it should be treated as any other cavity—by drainage.

The x-ray is of considerable assistance in determining the location of a cavity. In this patient, over the apex of the right lower lobe there is tubular breathing with increased tactile fremitus and bronchophony, suggesting the possible diagnosis of a pulmonary cavity. In the lower portion of the chest there is flatness, absence of tactile fremitus, and almost absent breath and voice sounds. To determine more accurately the condition in the lower part of the chest another exploratory puncture was made day before yesterday, but no fluid was obtained. The puncture findings are of importance in excluding, without doubt, the existence of an encysted, localized empyema which might have resulted from the gangrene. With the dry tap one must conclude that the physical signs over the lower portion of the chest are due either to a thickened, adherent pleura or to a filling of the lung from the liquefaction and destruction due to the gangrene. With the patient in an upright or semiprone position there is a constant tendency for the destructive products to gravitate into the lower portion of the lung. The proportion she expectorates is relatively small. The material expectorated is very irritating and quite frequently a purulent bronchitis results. To relieve

this condition these patients rest upon the involved side or assume the upright position, which means that there is constantly an accumulation of the material in the lower portion of the lung, and that probably accounts for the findings which are present here.

x-Ray Examination.—Two plates were taken. The first is an anteroposterior one, which shows the phrenocostal angle entirely free, excluding the possibility of fluid in the pleural cavity. In the diagnosis of a pulmonary abscess or pulmonary gangrene by means of the skiagraph the more advanced conditions are recognized by the presence of a cavity which reveals the presence of an air bubble above the fluid contents. On change of position of the patient there is also a change in the air bubble and fluid contents of the cavity as revealed in the shadow. For that reason this patient was first skiagraphed in the dorsal position and then in the lateral position, lying upon her left side. The findings here, however, are not those anticipated. The plates do not show the findings of a cavity.

How are we, with the physical signs indicative of a cavity, to account for these skiagraphs? Perhaps on the ground that the cavity is more or less filled with pus. The patient has not been expectorating a large amount during the last few days, and it is conceivable that the cavity may be more or less filled, and, consequently, there is no air-bubble present.

CLINIC OF DR. HERMAN L. KRETSCHMER

PRESBYTERIAN HOSPITAL

THE TREATMENT OF CHRONIC COLON PYELITIS BY PELVIC LAVAGE.

Frequency of Colon Bacillus Infection of the Kidney and Renal Pelvis.

Predisposing Factors—Sex, Pregnancy, Associated Pathologic Conditions, etc.

Three Routes of Infection. Cultural Methods Employed in the Diagnosis.

Pelvic Lavage Through the Ureteral Catheter the Ideal Method of Treatment.

COLON bacillus infection of the kidney and renal pelvis occurs much more frequently than is generally supposed. Its presence in children is very often overlooked, doubtless due to the fact that routine examinations of the urine are not made, owing to the difficulty in obtaining specimens. Careful examinations of the urine in children suffering with fever that cannot be explained will often lead to the demonstration of pus and *Bacillus coli* in the urine. Not only does this infection exist in infants and children, but also in adults and the aged. Colon pyelitis may be associated with senile enlargement of the prostate. The frequency with which *Bacillus coli* infections of the kidney occur was demonstrated in a series of 115 consecutive cases of infections of the urinary organs, excluding gonorrhea and tuberculosis; 38 proved to be chronic colon pyelitis.

Predisposing Factors.—Sex.—The female sex is more frequently affected by this disease than are males. This is especially true in cases occurring in infancy and childhood, reports of large

series of cases demonstrating the great preponderance of girls over boys. That boys can be affected more frequently than was formerly supposed is a fact being recognized at the present time. Klöwitz reported a series of 17 boys and 23 girls. His statistics support the view of some of the earlier writers, who gave higher figures than were generally quoted at that time—Goppert, 11 per cent.; Friedwald, 27.5 per cent.; and DeLange, 33 per cent. Some of the more recent reports, however, show a great preponderance of girls over boys. Thompson found 79 per cent. in girls; Still, 90 per cent.; Hatch, 80 per cent.; and Marsh, 90 per cent. It has been attempted to explain this great preponderance of girls over boys because of the short urethra in females, and also to carelessness in cleaning infants with the diaper in wiping forward. It is perfectly clear that these explanations do not suffice for all cases.

Pregnancy.—The demonstration of the pus and colon bacilli in the urine of pregnant women has cleared up many cases of unexplained fever, pyuria, and albuminuria that occurred during pregnancy. Each case of unexplained fever, with or without chills, occurring during pregnancy calls for a careful chemical, microscopic, and bacteriologic examination of the urine.

Many theories have been advanced to explain the occurrence of colon pyelitis during pregnancy. Because of the many theories advanced it is reasonable to assume that any one does not satisfactorily explain the occurrence of this condition. One theory that seems quite reasonable maintains that the pyelitis of pregnancy is a lighting up of an old infection from which the patient suffered during infancy and childhood. This seems reasonable enough clinically, for at times one may be able to elicit a history of "bladder trouble" during infancy or childhood which would tend to substantiate these views.

Compression of the ureter by the pregnant uterus or fetal parts has been one of the more frequent reasons given. There have been many objections to this view. It is believed that the uterus is incapable of exerting enough pressure on the ureter to compress it, and, furthermore, pyelitis occurs at times early in pregnancy before the uterus is large. If compression of the ureter

is a factor in the production of pyelitis, this condition should be found more frequently than it is, associated with fibroids and ovarian cysts.

Of interest in this connection is the fact that dilatation of the upper urinary tract occurs frequently during pregnancy and may exert a predisposing rôle, dilatation being often accompanied by urinary stasis. It has been variously estimated that dilatation can be demonstrated in about one-third of all pregnant women. Changes in the bladder mucosa (hyperemia, edema) may result in a stagnation of urine and so predispose to infection by *Bacillus coli*.

Interference with kidney drainage may occur at one of the three physiologic constrictions of the ureter and perhaps be a predisposing factor.

Matrimony.—At times colon pyelitis occurs in newly married women. This type of colon pyelitis has been called “defloration pyelitis,” and has been described repeatedly. Tears of the hymen have been suggested as portals of entry of the infection.

Associated Pathologic Conditions.—In a certain percentage of cases the colon pyelitis is purely a secondary consideration; this fact should always be borne in mind lest the real lesion be overlooked. Colon pyelitis often occurs associated with stone in the renal pelvis, hydronephrosis, calculus, or stricture of the ureter, vesical calculus, benign hypertrophy of the prostate, as well as chronic prostatitis, uterine fibroids, carcinoma of the uterus, etc. These facts must be carefully considered when selecting cases for treatment by pelvic lavage.

Surgical Operations.—When colon infections of the kidney occur following surgical operations they may be mixed. Colon pyelitis sometimes follows operations for appendicitis, and not infrequently occurs after extensive gynecologic operations.

Acute Infectious Diseases.—Colon pyelitis has been observed after patients have been ill with some of the acute infectious diseases, especially grip, pertussis, and measles. It is generally believed that the acute infectious diseases light up an old latent infection.

Gastro-intestinal Disturbances.—Because of the large number

of cases occurring during the summer months in children who have had recent attacks of gastro-enteritis it would make it appear as though the gastro-intestinal disturbances were a predisposing factor. This incidence has been frequently noted and reported, especially by pediatricians. Furthermore, chronic constipation may play a predisposing rôle, many patients with chronic colon pyelitis giving a history of chronic constipation. Asch has reported 4 cases of chronic constipation, in whom he was able to demonstrate colon bacilli in the urine in pure culture. The treatment of the constipation was followed by a complete disappearance of organisms from the urine without the use of urinary antiseptics or local treatment. That gastro-intestinal lesions may be predisposing factors in metastatic colon infections has been noted clinically. In a case reported by Tavel, who had operated upon a patient for goiter, there occurred an infection of the wound with *Bacillus coli*, the patient having previously suffered from a severe gastro-enteritis.

Routes of Infection.—The colon bacillus being an inhabitant of the intestinal tract, the question that most naturally would suggest itself is, "How does the colon bacillus get into the kidney?" The three possible routes of infection are:

- (1) Hematogenous—by the blood stream.
- (2) Lymphogenous—by the lymph stream.
- (3) Urogenous—via the urine.

The hematogenous route is the one believed by many to be the most frequent way in which the colon bacilli reach the kidney. One of the chief objections to this mode of infection has been the fact that although this disease occurs frequently, and many cases have been reported in the literature, there are only a few reported cases in which it has been possible to isolate the organisms from the blood stream. Cabot believes these failures are due to the fact that cultures are made too late in the course of the disease; that, in order to demonstrate the organisms in the blood, cultures must be taken very early after the onset of the disease (within six hours). Nevertheless, it is striking that the number of cases reported is very large and the number of positive cultures is very small.

Lymphogenous.—At the present time the general consensus of opinion is in favor of the lymphatic route for these infections. One of the most important contributions on this phase of the subject has been the work of Francke, who made careful dissections of the lymphatics of the large intestine. He was able to show by means of his injected preparations that the lymphatics of the end of the transverse colon, splenic flexure, descending colon, and part of the sigmoid pass over or across the capsule of the left kidney. He was further able, by means of his preparations, to demonstrate that the lymphatics of the cecum and ascending colon pass over the capsule of the right kidney. In some of the cases he was able to inject the lymphatics over the right kidney from the appendix. According to the work of Stahr, there exists a direct communication between the lymphatics of the kidney capsule and the deep lymphatics of the kidney substance. It would seem from these anatomic facts that a direct route exists between the large bowel and the kidneys, and it is easy to understand how lesions of the colon could easily predispose to infections of the kidney by the colon bacillus.

As further proof of the clinical significance of his findings, Francke mentions the work of Krimow, who demonstrated three lymphatics in the fatty capsule of the kidney. These same three glands were found diseased at autopsy in eight children who had *tabes mesenterica*.

Urogenous.—The possibility of the ascending route of infection has been recognized for a long time. This has usually been inferred to occur directly along the mucous membrane of the ureter, from the bladder to the higher urinary tract. In these cases the bacilli passed directly from the bladder into the kidney via the mucous membrane. That the ascending route of infection is possible has been proved clinically as well as experimentally in the lower animals. It has been proved that under certain conditions an antiperistaltic movement may take place in the ureter, so that the contents of the bladder may be propagated into the kidney, and that a partial filling of the bladder is sufficient to dissipate the closure of the ureteral orifice, so that each variation in the intravesical pressure is transmitted to the

renal pelvis. This work has been carried out on the lower animals.

I have been able to demonstrate the occurrence of this phenomenon in the human by injecting a solution of thorium nitrate into the bladder and obtaining röntgenograms. In this way it has been possible to demonstrate that regurgitation of the fluid from the bladder into the kidney pelvis does occur in man. This I have been able to demonstrate in adults as well as children who were free from any disease of the urinary organs. On the other hand, if ulcerative processes are present around the ureteral orifice so that the opening gaps, or if a chronic retention exists due to an obstructive lesion of the lower urinary tract, such as prostatic hypertrophy or lesions of the central nervous system, ascending infection can easily be explained.

That ascending infections do not necessarily follow along the mucous membrane, and that they may reach the kidney from the bladder through the lymphatics, is proved by the magnificent work of Bauereisen, who has demonstrated that a direct connection of the lymphatics of the bladder and kidney exists through the lymphatics of the ureter. This no doubt accounts for many of the cases of ascending infection of the bladder to the kidney without an involvement of the ureteral mucosa. As is well known, one meets cases at autopsy who have pyelitis and cystitis without any involvement of the ureter.

Diagnosis.—An accurate diagnosis must rest on the isolation of the colon bacilli from the urine. The exact localization of the infection must be made by means of the cystoscope and ureteral catheter. This method can be employed in adults without any trouble or difficulty. One may meet certain limitations in very young children; because of the size of the instruments it may be impossible to catheterize the ureters. That this can be carried out more often than is thought possible I have been able to demonstrate, having catheterized ureters in children two to three years old. In children, when one is not able to catheterize the ureters, one is able to employ plain cystoscopy, and in this way to exclude the bladder as a cause of the infection. The youngest female child that I have cystoscoped was nine months old.

It may not be out of place to digress for a few minutes on the cultural methods that we have employed in the management of these cases, results of which were recently published in collaboration with F. W. Gaarde, in the *Journal of the Amer. Med. Assoc.*, June 24, 1916. We found that a growth of the colon bacillus was readily obtained on plain agar. As a rule, however, several kinds of media were used; namely, blood-agar slants, aërobic and anaërobic, blood-agar plates, and dextrose ascites broth. These various media were used in order to meet any cultural peculiarities which the organism might have. We have repeatedly seen instances in which a growth was obtained on only *one* of the four media inoculated. It seems necessary, therefore, because of the possibility of failure of the colon bacillus to grow on several media that three or four inoculations of each specimen be made. Attention should be called to the necessity of controlling the cultures by staining the sediment of the urine. Occasionally it has been our experience that all of the cultures would remain sterile, yet the stained sediment would show organisms. Unless this is done it would be easy to overlook the presence of micro-organisms.

Treatment.—This cannot be carried out in a haphazard way. It must be based upon an accurate diagnosis. In selecting patients for treatment by pelvic lavage it is well to bear in mind that many cases of pyelitis are associated with organic diseases of the kidney, its pelvis or ureter, such as stone, stricture, or tuberculosis, with prostatic hypertrophy and vesical calculus. This group requires proper surgical treatment. In several of our cases we have found an associated chronic prostatitis and seminal vesiculitis, and it is needless to call attention to the fact that this group of cases should be subjected to the appropriate therapeutic measures. In at least one instance we believe that neglect of chronic prostatitis has been responsible for three distinct relapses which one of our patients had. Röntgen ray examination, pyelography, and guinea-pig inoculation must be resorted to when there is doubt.

Pelvic lavage through the ureteral catheter is undoubtedly the best single agent for the treatment of this condition that

we have at our command. This form of treatment is simple, and can be carried out without much inconvenience to the patient, has given us a larger percentage of cures than any other treatment, and in the event of relapses can be carried out again. The objections to this form of treatment have been not of the method as much as of the drugs employed. Undoubtedly there are instances in which the patient can be relieved irrespective of the drug used. Indeed, I have seen several instances in which the patients were subjected to cystoscopic examination and ureteral catheterization for diagnosis; the cystoscopic examination and ureteral catheterization were followed by a complete cessation of symptoms. The technic employed has been the routine use of a 1 per cent. solution of silver nitrate. The amount of solution injected has varied from 5 to 10 c.c.

It is of the utmost importance, when carrying out this treatment, to avoid a rapid filling of the pelvis and not to use too large amounts. If the injections are carried out slowly, and one avoids overdistention of the pelvis, there is practically no pain except that incident to instrumentation. As a rule this form of treatment is carried out every five or seven days. The patients are put to bed following this treatment and given large quantities of water to drink. This treatment has given us more cures than any other single method. No patient was discharged as cured who did not fulfil two requirements—first, the urine had to be free from pus; and, second, cultures of the urine obtained with a ureteral catheter had to be sterile. To free the urine of pus was a relatively easier task to accomplish than it was to obtain sterile cultures. We have repeatedly seen the urine free from pus and a disappearance of the clinical symptoms following one or two treatments, but the cultures would still show the presence of colon bacilli. It is evident that too much stress cannot be laid upon this fact, and it is easy to understand why many of the cases relapse if the treatment is stopped before the cultures are sterile. Furthermore, it is essential to relieve any focus which may be the cause of the relapse. Attention has already been directed to the necessity of treating prostatitis and seminal

vesiculitis. In many of our cases we obtained sterile kidney specimens long before the bladder urine became sterile. It is essential, therefore, that the treatment of the bladder must be continued until it too is free from colon bacilli.

This form of treatment can also be carried out in children. Whenever it is carried out it is necessary to employ some form of general anesthesia. The use of the ureteral catheter has also been employed for purposes of draining the kidney pelvis by allowing the ureteral catheter to remain *in situ* for twenty-four or forty-eight hours.

Pyelitis during pregnancy lends itself very well to this form of treatment. It is a well-known clinical fact that after the uterus is empty the symptoms of pyelitis subside. Based upon this fact, the obstetrician treats pyelitis during pregnancy by emptying the uterus. It would appear as though this form of treatment is rather severe when other more simple measures will suffice. Many of these cases are reported as cured by the obstetrician. Whether this is so or not is questionable, inasmuch as the reports contain nothing with reference to the bacteriologic examinations of the urine. With the introduction of pelvic lavage in the treatment of pyelitis and its application in the treatment of pyelitis of pregnancy one is justified in stating that the pregnant woman should be given the benefit of this form of treatment before the pregnancy is interrupted. In those cases in which the kidneys promptly yield to treatment, and in whom the bladder urine still continues to harbor pus and colon bacilli, it is well to institute permanent bladder drainage by means of the indwelling catheter.

The cases of pyelitis during pregnancy that were associated with residual urine in the renal pelvis were treated by draining the residual through the ureteral catheter. The pelvis was then irrigated with sterile boric solution or water until the wash water returned clear, then the instillation of silver nitrate was made.

Internal Medication.—Internal treatment is the one usually first resorted to, and is the one on which we are most dependent in children. Most of our cases had been treated with internal medication before pelvic lavage was instituted, but nevertheless

the internal treatment was continued. Of the internal remedies, urotropin or some of its modifications heads the list. The internal treatment was carried out as follows: The first week after the diagnosis was made the urine was rendered alkaline to litmus by the administration of bicarbonate of soda or potassium citrate, the following week the urine rendered acid by the internal administration of acid sodium phosphate. During this period urotropin was given in doses as high as 75 gr. in twenty-four hours. This form of treatment was given during alternate weeks—*i. e.*, one week alkalies and the next week acids and urotropin.

CLINIC OF DR. CHARLES SPENCER WILLIAMSON

COOK COUNTY HOSPITAL

POLYCYSTIC KIDNEYS

**Clinical Picture Simulating Chronic Interstitial Nephritis.
Presence of Bilateral Abdominal Tumors of Considerable Size.
Diagnostic Procedures Necessary to Identify Kidney Tumors.
Value of the Phthalein Test. Pathology of Polycystic Kidney.
Demonstration of Specimens.**

THE patient whom I wish to present today is a Swedish teamster, forty-four years of age, whom I have had under my personal observation for the past three or four years. At the present time he is on the neurologic service in the hospital, and it has been rather difficult for the intern to secure a very clear history from him because of his poor condition. As I know the patient and his previous condition very well, I will supplement the history by what I have learned about him on previous occasions.

When I first saw him, perhaps some four years ago, he came into my dispensary clinic complaining of headache and pains of a sharp and shooting character in the upper part of the abdomen, confined largely, although not exclusively, to the right side. At that time he stated that he had had a paralytic stroke several years before, from which, however, he fully recovered in three months. Another attack about a year later left him with numbness of the hand and leg. The functional capacity of the extremities was good, and at that time he was working as usual. I have not my notes of his condition at that time at hand, but I can give them to you with a fair degree of accuracy from memory.

His general condition four years ago was good. There were no findings about the head and neck to account for his headaches.

His lungs were normal. Examination of the heart showed a very great hypertrophy of the left ventricle, with a markedly increased second aortic sound. The blood-pressure was well over 200. It goes without saying that these findings led to the immediate examination of the urine, and this revealed all the evidences of a chronic interstitial nephritis; namely, low specific gravity, large quantity, and a mere trace of albumin, not always present. The patient said at this time that there had been at least two occasions on which he had passed considerable quantities of blood in the urine. He was not to be shaken from this statement. The blood had come for several hours at a time; on one occasion he thought he had passed it for a day, and the blood had been in sufficient quantities to make the urine plainly red.

On examining the abdomen a very interesting condition was found. On the right side, extending down $1\frac{1}{2}$ or 2 inches below the costal arch, was a tumor mass, felt with great ease after the bowels had been thoroughly emptied. This mass was moderately firm and distinctly nodular, giving one the impression of large, soft nodules. The tumor moved freely with inspiration. It was not especially tender, and could be pushed somewhat toward the midline, but had no great range of mobility. On the left side in the corresponding position a mass could be made out very indistinctly and much smaller than the one on the right side.

When we consider the findings as they were at that time it is very evident that the patient had a chronic nephritis of some sort, and it is highly probable that his headache was due to this nephritis. Examination of the eyegrounds at this time disclosed slight changes which confirmed this diagnosis. The question arose, however, as to the nature of the tumor mass in either side of the abdomen. At first the tumor on the right side felt more like a gall-bladder than anything else, except that it did not consist of a single, firm, fluctuating mass. Then it extended so far back in the flanks as to make us think of the right kidney. We then instituted steps to ascertain to which of these organs the tumor mass belonged. On inflation of the stomach it was very evident that no appreciable effect upon the tumor was

produced, except perhaps to render its mesial border a little less readily palpable. On inflation of the colon, however, it was very plain *that the colon passed in front of the tumor, since a band of resonance could be traced quite accurately running across the lower pole of the tumor.* This, of course, gave us very important information, since it made it clear that the tumor was retroperitoneal, and in this location it could scarcely be anything else than the kidney.

This conclusion was greatly strengthened by the fact that on the left side the tumor mass, already tolerably indistinct, was completely obscured by inflation of the colon, showing that it, too, was retroperitoneal. So this fact, added to the fact that the tumor was bilateral, made it practically certain that we were dealing with a bilateral enlargement of the kidneys.

About this time, because of the great interest in the case, I exhibited this patient at one of the branch meetings of the Chicago Medical Society, and a considerable discussion occurred at that place, several colleagues believing that it was a large gall-bladder on the right side, since they could not convince themselves with certainty that there was a definite tumor on the left side. The substance of my remarks on that occasion and the diagnosis I made I will give you in brief, and we will then trace the further course of the disease to the present and see what his condition is now.

Differential Diagnosis.—Having ascertained to my own satisfaction that the two masses represented the right and left kidneys respectively, the next question was, what was the nature of the enlargement? Clearly, it was not a simple case of nephritis of any type, since this would never produce a kidney of such size. Bearing in mind the hemorrhages, our minds will at once turn to a *malignant neoplasm*. The patient at that time was in good physical condition; he had not lost much weight, and did not seem to be in a condition which could be considered cachectic. He had, however, complained of constant pain both in the right and left hypochondriac regions. This, of course, is always suspicious of some type of neoplasm. On the whole, however, the evidence seemed to me then to speak against a hypernephroma,

since, if I was correct in my belief that both kidneys were enlarged, we would have to assume that he had a hypernephroma in each kidney, which would be an almost unthinkable coincidence. Then, too, we would be unable to explain the existence of the high blood-pressure, which is ordinarily not materially affected by a hypernephroma.

Bilateral hydronephrosis needed to be considered. We might conceive that either owing to stone or other obstruction of considerable degree the right kidney had developed into a hydronephrotic sac. The general feeling of the tumor, however, impressed one that there were a number of small sacs rather than one large one, and this is not the rule in a hydronephrotic kidney. Hemorrhages are exceptional, but can occur in hydronephrosis, so this was not absolutely against the diagnosis. On the other hand, it would be again a remarkable coincidence to have a bilateral hydronephrosis. I have myself never seen such a case except of very moderate degree, and then only when the obstruction was in the lower urinary passages.

One might think of a bilateral pyonephrosis, which is sufficiently common after obstructions low down, but these rarely attain anything like the size of the kidneys in question, and there was no evidence of obstruction low down in this patient, nor were chills, fever, etc., present. The diagnosis of pyonephrosis was, therefore, utterly untenable.

On the other hand, there is another condition which, while rare, fits in very much better with the facts before us than any of these suggestions. I refer to the so-called *polycystic* or *congenital cystic kidney*. This produces tumors of considerable size, and at the same time destroys the renal tissue to such an extent as to produce the picture of a contracted kidney, with polyuria, albuminuria, low specific gravity, high blood-pressure, etc. In addition, one finds in this condition attacks of pain the origin of which is not quite clear. The occurrence of hemorrhages in this condition, however, is very well ascertained. There was, therefore, absolutely no symptom lacking, and I had no hesitancy in saying at that time that the case was one of congenital cystic kidney, and I so demonstrated him in my clinic.

I had not seen the patient up to two or three days ago, when the intern on the neurologic service called me up and asked me to see a patient there whose wife said that I was very much interested in his case. I did so, and found my old friend in a rather lamentable condition.

Now let us read from the history, supplemented by what his wife tells us, what has happened to him since I saw him several years ago. It seems that he has had off and on repeated attacks of what she calls "stomach trouble"; that is, he had attacks of sharp, at times quite violent, pain in the hypochondriac region, with nausea and at times vomiting. We hear that he had slight convulsions twice last spring. He was told then that they were epileptic in character. On the day before admission, which was almost four weeks ago, the patient began to vomit at about 8 o'clock in the morning, just after his breakfast. These attacks came in spells, but as he had had these spells off and on rather recently he did not think much of them. Associated with this vomiting was a pain in the "stomach" and in the right hypochondrium. The pain lasted all day, was of a sharp, stabbing character, referred to the sides and the legs. He was not unconscious. Toward evening his speech became more or less thick and he found himself unable to speak satisfactorily, although he could think of the words he wanted to use. As the pain and vomiting continued and as his mental condition was becoming worse it was decided to bring him into the hospital, and he was admitted with the examining-room diagnosis of "cerebral thrombosis."

Personal History.—His wife states that he drank very moderately. He himself managed to say that he had had gonorrhea eight years previously and a soft chancre fifteen years ago, but denied lues.

Marital History.—He has been married five years; there are no children. His wife had one pregnancy, the child being born dead at seven months.

Family History.—We inquired with particular care into the family history, and learned that his father died at fifty-five of alcoholism; his mother died in childbirth. He had nine brothers

and sisters; three are dead, the rest living and well. There is no history of any kidney trouble in the family.

Physical Examination.—Let us now look over the patient and see what we can find out at the present time. The man is still well nourished and looks to be about his age, forty-four. His mentality seems approximately normal, although, because of the difficulty in speech, the first impression obtained is that he is stupid.

Head and Neck.—*Eyes.*—The pupils are equal and react to light and accommodation; there is no nystagmus and no strabismus. An examination of the eye fundus shows a bilateral neuroretinitis. There is no overdistention of the cervical veins. The tongue is coated and tremulous, but moves in all directions. The neck is negative.

The Chest.—The *lungs* show nothing abnormal. The apex-beat of the heart extends to one fingerbreadth beyond the nipple line, and is full, strong, and heaving. The sounds are roughened, with very marked accentuation of the second aortic, which is ringing as well.

The Abdomen.—The liver dulness is approximately normal; the lower edge can be felt on deep inspiration, but does not come down further than it should. On drawing the patient's knees up and palpating in the region of the right kidney we find a large mass extending down to about 1 cm. above the umbilicus and giving the impression of a tumor of very considerable size and density. I have in mind quite clearly the size of this tumor when I examined it several years ago, and am quite confident in my own mind that it is fully half again as large as it was then. On the left side the kidney can also be plainly felt, although it is not so large as on the right. It extends down about three fingerbreadths below the costal margin, and also gives the impression of being a tumor of quite substantial dimensions. That these masses are really the kidneys seems to me to be scarcely susceptible of argument.

To begin with, if you are standing on the right side of the patient, as I am now doing, putting the left hand underneath, in the flank, one can carry out the "ballottement renale" which is

so very characteristic of a renal tumor. On the left side this can also be done, but not quite so readily. The patient's bowels were thoroughly cleared out before he was brought down, so we will now endeavor to inflate the colon, and I will see if I can demonstrate to you the way the colon passes over these tumors.

(Demonstrating): Now that we have the colon fairly satisfactorily filled with air, you will see that on the right side the

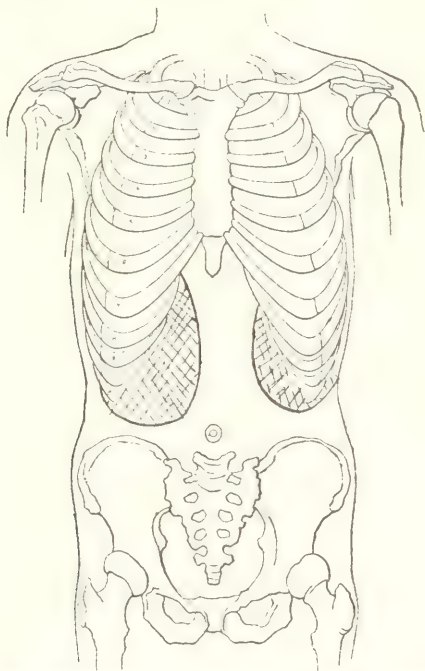


Fig. 96.—Congenital cystic kidneys. Outlines of the kidneys as determined by palpation.

lower portion of the tumor is palpable only with much difficulty. I interpret this as meaning that the tumor in its growth has pushed the colon downward so that the latter covers only the lower portion of the kidney. On the left side the same thing holds true. The tumor can still be palpated, but with great difficulty.

To my mind there is no question that these tumors rep-

resent enormously enlarged kidneys, and the arguments I advanced several years ago for believing that they were cystic kidneys apply in just the same measure now. Indeed, they apply in even greater measure; the tumors have grown definitely larger, they are painless, or, more properly speaking, they are not tender, because there has been severe pain at frequent intervals. There is no increase of temperature and no increase in the leukocyte count. The long duration of the disease makes it even more certain now than it was then that we are not dealing with a malignant neoplasm which could inconceivably have lasted as long a time as this has, and especially would not have left the patient in such good nutrition. One of the things which might be done is to inject the calices of the kidneys with collargol or similar solution and take an x-ray plate of them afterward. We have, however, considerable confirmation of the diagnosis from another source, namely, the examination of the urine. Since he has been in the hospital, approximately four weeks, numerous examinations of the urine have been made. All of them have shown a low specific gravity, approximately 1010. The quantity has been increased materially, although because of his stuporous condition much of it has been voided involuntarily. Some of the samples have shown blood in considerable quantities. Indeed, one analysis is marked "loaded with blood." At other times there have been only a few corpuscles, and still other specimens have been completely free.

The blood-pressure at the present time is 190 systolic. The blood count shows nothing abnormal and there is an absence of leukocytosis.

In just such cases as this the determination of the functional capacity of the kidney is of the very greatest importance. If there is any question as to a given mass being a tumor of the kidney or not, this examination will sometimes cast the deciding vote in favor of or against the tumor belonging to the kidney. Tumors of such size as this are practically certain to interfere very materially with the output of phthalein, and so we would expect that if my contention is correct, namely, that these masses represent bilateral kidney tumors, the output of phthalein would be very

greatly decreased. This has already been done, and we are informed as to what the output is. In the morning, after catheterization and drinking about 1 pint of water, 1 c.c. of phthalein solution was injected into the lumbar muscles. The catheter was allowed to remain in for many hours, in fact, all day, and by evening not a drop of phthalein had come through. Late that night the patient urinated again and no phthalein could be found. That test was day before yesterday, and it was repeated this morning, and as yet (about 4 P. M.) no phthalein has come through, so it is plain that this man's kidneys are excreting practically no phthalein, and from this we can draw another conclusion. Not only are these masses tumors of the kidney, as evidenced by the almost total destruction of the kidney parenchyma, but the phthalein output being almost entirely gone indicates that the patient's symptoms—his stupor, headache, vomiting, etc.—are uremic in nature.

My experience in such cases is that when the output of phthalein is actually nothing, or even substantially nothing, the end is not far off, and I believe that this man has but a short time to live.

To sum up the question, then, I adhere to my original diagnosis of very large polycystic kidneys, and I interpret the present condition to be the logical outcome of such a disease. The gradual destruction of the kidney substance by the growth of the cysts means precisely the same ultimate end as a chronic interstitial nephritis, and the patients generally succumb either to uremia or to one of the conditions associated with a high blood-pressure, namely, cerebral hemorrhage or cardiac failure.

Let us now examine briefly the patient's nervous system and see what the condition is there. We find the extremities, both arms and legs, negative, and there is no sign of paralysis. The patellar reflexes are present; the Babinski on the right is doubtfully positive and negative on the left. The abdominal and Achilles reflexes are present. The patient is becoming more and more stuporous, and the only question which might arise is as to whether this is due to uremia, which he almost certainly has, or to uremia plus a cerebral hemorrhage. The latter would seem improbable,

in spite of the fact that he has a double optic involvement, because of the absence of all paralysis. It is probable that the old paralyses were due to small hemorrhages. We have not lost sight of the possibility of his having some other cerebrospinal condition, and so have made an examination of the spinal fluid. There are 40 cells per cubic millimeter, the Wassermann, Nonne, and Ross-Jones tests all being negative. The explanation of this increase in cells is not quite clear. I do not wish to enter further upon the neurologic aspects of the case.

Nature of the Disease.—The polycystic or, as it is probably better called, the congenital cystic kidney is a tolerably rare condition and well-marked examples are by no means common, certainly not in the general wards of a hospital. The theories of its origin are numerous, and there is no general agreement among pathologists as to even the principal facts. The following points, however, seem pretty clear: The disease is almost always bilateral. The true congenital cystic kidney very rarely, if indeed ever, affects one kidney only. It must not be thought that every cyst in the kidney justifies the description of the kidney as belonging to this type, because isolated cysts, when small, even if they occur in considerable number, do not affect the kidney parenchyma very materially. Virchow held that they were retention cysts due to inflammatory changes at the apices of the papillæ. Subsequent researches have shown, however, that this postulated condition is not always present. Another theory regards the disease as being a true tumor formation. To my mind this seems improbable, because it would certainly be a remarkable coincidence if it should invariably affect the two kidneys to an equal degree. A third theory regards the condition as being developmental in origin, and as being due to a failure in communication between the upper and lower segments of the uriniferous tubules. This theory, to my mind, is by far the most likely. You will remember that one part of the uriniferous tubules, namely, the part which is most concerned in secretion, takes its origin from the renal vesicles, whereas the collecting tubules are outgrowths from the Wolffian duct. If, now, the

union which normally takes place between these two portions fails to occur, we have the process of secretion going on just the same, and the Malpighian corpuscles develop into cysts which ultimately attain a very considerable size. It is not very uncommon for individual cysts to reach the size of a walnut, and sometimes they are much larger. As a matter of fact, the contents of the cyst vary decidedly. They may be clear and colorless, containing only a slight amount of uric acid or perhaps hippuric acid, or they may be thick and more or less gelatinous, often-times brownish as a result of admixture of blood. It is supposed, although not certainly demonstrated, that the presence of blood is due to a rupture of small vessels in the walls of the cysts. This would account for the hematuria which occurs in perhaps something like 50 per cent. of the cases clinically.

It is very important that we differentiate clearly between the true polycystic kidney and the cysts which are the usual accompaniment of a chronic interstitial nephritis. These latter are small affairs, rarely ever larger than a bean, and do not cause any material increase in the size of the kidneys. They are simply small retention cysts due to a development of connective tissue in cases of chronic interstitial nephritis.

Clinically, the outstanding features of the polycystic kidney are very well shown by the case before you. They are: *First, development of tumor masses of considerable size which in all the instances I have seen could be readily palpated, and frequently their cystic nature was reasonably clear, as it is in this case. Second, the destruction of the kidney substance gradually produces a picture identical with that of a chronic interstitial nephritis with polyuria, low specific gravity, high blood-pressure, the presence of a few casts, very greatly diminished phthalein output, cardiac hypertrophy, etc. Third, the occasional occurrence of hemorrhages, while more or less accidental in nature, is so conspicuous a symptom that it should always, when occurring in what is presumably a case of contracted kidney, call attention to the possibility of the existence of a polycystic kidney. In the same way, of course, the duration and termination of the disease are substantially that of a chronic interstitial nephritis, ending, as I have already said, either by uremia,*

cardiac failure, or one of the accidents incident to high blood-pressure.

In regard to the **prognosis** in cases of this sort the outlook is neither better nor worse than that of cases of chronic interstitial nephritis. I personally have never seen a case that was not bilateral, and I should be rather skeptical of any case that was supposedly unilateral being a true polycystic kidney.

The **treatment** is identical with that of chronic interstitial nephritis. Nothing is to be expected from surgical treatment, since if a kidney was removed nothing would be gained, for the size of the tumor does not interfere materially with the individual's comfort. Cases have been recorded where the kidneys were of such size as to form an actual obstruction to delivery. These cases rarely survive any length of time.

Additional Notes Two Weeks Later.—I want to report to you today the subsequent course of the case I showed you two weeks ago. The course was not materially different from what it had been, the patient continuing to go steadily downward. He became more and more stuporous, gradually went into coma, and died in that condition. In addition, the vomiting became more and more marked and in the last few days he was unable to retain any nourishment. There seems little doubt that uremia was the cause of death, just as we had predicted. He lived, however, longer than we had anticipated, since he did not die until yesterday. We were fortunate enough to get a partial autopsy, and you will see here the specimens from the case. They represent the largest pair of polycystic kidneys I have ever seen and are absolutely typical in every way.

The description of the kidneys, as given by the pathologist, is as follows:

The kidneys are enormously enlarged. Their contour resembles roughly that of the normal kidney. They weigh together 3100 grams. The right is slightly larger than its mate. It measures 24 cm. from the superior to the inferior pole, while its greatest diameter is 12 cm. The left kidney measures 23 cm. in its greatest dimension by 13 cm. in width. The kidney capsule

has an average thickness of 2 to 3 mm. The external surfaces are everywhere nodular and irregular, due to the presence of multiple cysts in the kidney parenchyma beneath the capsule.

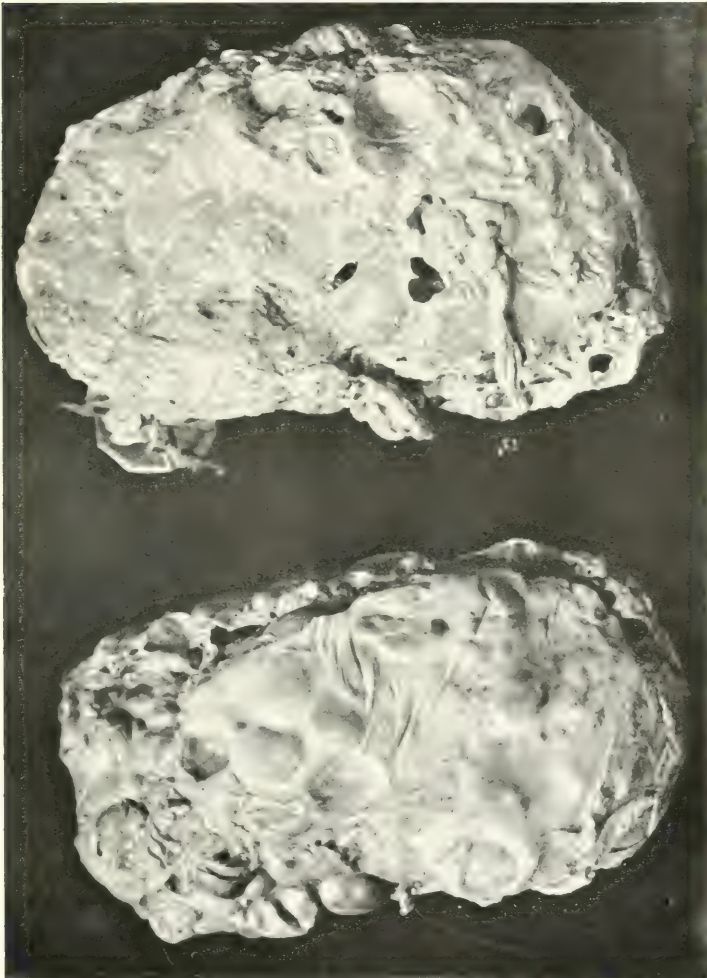


Fig. 97.—Polycystic kidneys—external view.

Upon sectioning the kidneys in the usual manner the entire parenchyma is seen to be replaced by countless numbers of cysts, varying in size from a hen's egg to a pea. Many of these cysts are filled with dark blood, while others contain a clear serous or

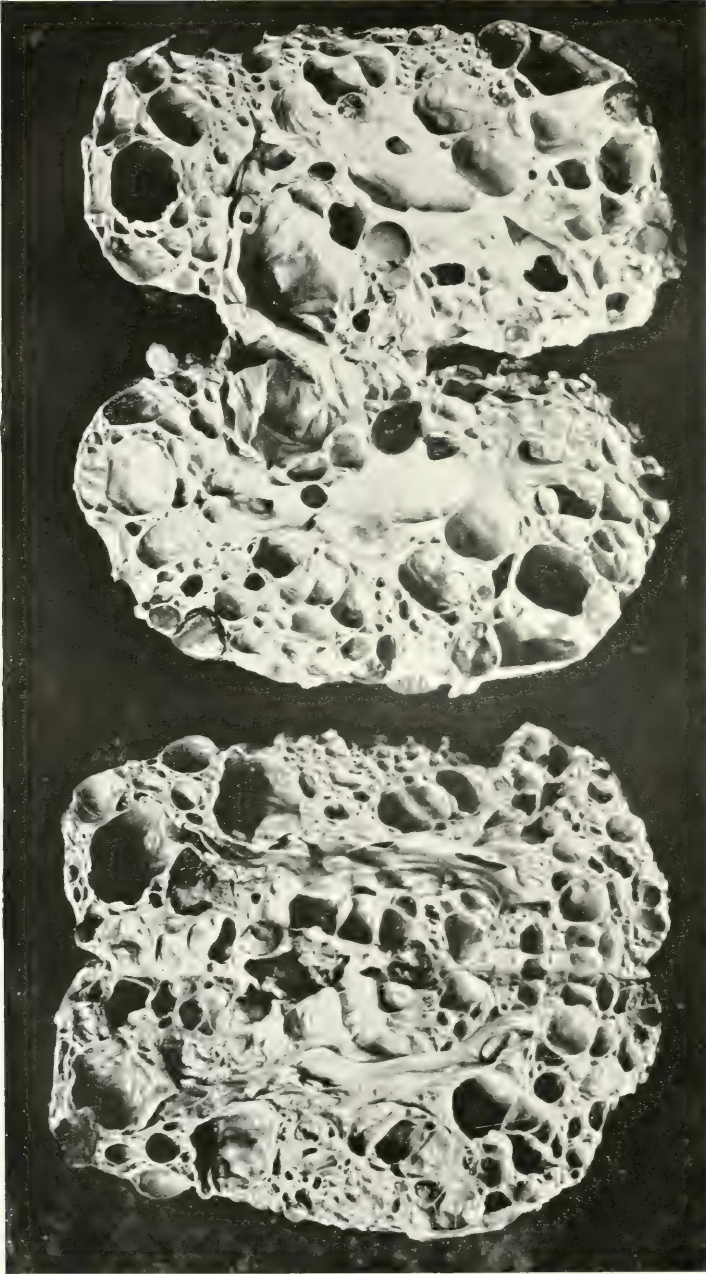


Fig. 68.—Polycystic kidneys—cut surface.

straw-colored fluid. Some of the larger cysts contain a dark-brown chocolate-colored material of colloidal consistency.

In the interspaces between these multiple cystic tumors only a very small amount of kidney parenchyma still remains. The pelves are encroached upon by these cystic tumors. There is no stenosis or dilatation of either ureter; they are entirely normal.

A CASE OF RECURRENT ENDOCARDITIS WITH CEREBRAL EMBOLISM

Acute Exacerbations Common in An Old Endocarditis. Liability to Formation of Emboli in These Cases. Multiple Infarcts in the Spleen. Streptococcus Recovered from the Blood.

THE second case which I want to present to you today is an emergency case which came into the hospital just a little while before I came down to the clinic. It seemed to me that it would be instructive to go over the case with you and see what we can make out of it in the absence of practically any history. We know almost nothing about the patient, and yet from the brief examination I have already made I think we shall be able to come to a diagnosis.

The patient is a Pole, and through one of his friends who came in with him we have secured the following very meager history: First we learn that he has had some sort of an illness for a considerable period of time, but has been able to be up and around for some weeks past. A day or two ago, the friend does not know exactly when, the patient became unconscious for a short time, and when he regained consciousness he could not speak. Beyond this we have not been able to elicit any history.

Physical Examination.—As we look at this patient we see that he is probably thirty or thirty-five years old, and that he is rather pale and drawn looking, giving the impression of having been sick for some time. The eyes react to both light and accommodation, and when we test the lids we find that on attempting to raise them the right comes up with ease, the left with considerable difficulty. On asking the patient to wrinkle up his forehead he responds fairly promptly, showing that he understands the request, and we see a very slight but definite difference between the left and the right sides, the right being slightly parietic. Inspection of the mouth shows a definite asymmetry. On

the right side the cheek is plainly flaccid, and when we ask him to blow out or attempt to whistle we see a confirmation of this statement. On looking at the throat we find the tonsils enlarged and red; the teeth are markedly carious.

The *chest* is symmetric; expansion is good. The *lungs* are perfectly normal with the exception of an occasional râle over the base posteriorly.

The Heart.—The apex is in the fifth interspace and behind the sixth rib, in or a trifle outside the nipple line. The apex-beat is about three fingers in width, fairly well circumscribed, and strongly heaving. On palpation we find the apex-beat very irregular, and this irregularity is atypical; that is, the irregularity pursues no system. This is the characteristic auricular fibrillation. With the stronger beats a definite presystolic thrill can be felt. The transverse diameter is considerably increased both to the left and to the right, extending out fully four fingers or a little more to the left of the sternal edge and fully an inch to the right of the sternum; above, the absolute dulness reaches nearly to the third rib. On auscultation at the apex we hear the first sound plainly, followed by a loud, rather harsh, systolic murmur heard with maximum intensity at the fifth interspace and an inch inside the nipple. It is clearly transmitted toward the axilla. Because of the great irregularity of the pulse auscultation is difficult, but occasionally one can hear a definite presystolic murmur. The second pulmonic sound is greatly increased. The blood-pressure is 109 systolic, 85 diastolic.

The *abdomen* is symmetric, slightly distended, and a trifle tympanitic. At present the liver is not palpable nor does it seem to be tender. The spleen is just palpable on deep inspiration. There are no evidences of tumor masses and no especial points of tenderness over the abdomen.

The Extremities.—On examining the hands we notice that the finger-tips are definitely cyanotic, with just a suspicion of clubbing. On asking the patient to raise his arms, he responds rather slowly, and raises the left very well, but not the right. To be sure that he understands me I will ask the interpreter to repeat the question. You will see the very evident effort he is making, and

he raises the left arm only. On grasping the hands and raising them, the right drops as though it were perfectly dead, the left comes down gradually, so he has a very evident paralysis of the right arm. Repeating the same maneuver with the legs, we see that the right leg is also completely paralytic. On pinching the skin in various places over the extremities he seems to respond a little less promptly to a touch or a pinch on the right arm and leg than on the left. The difference is so slight that I cannot be sure of the correctness of it.

The Reflexes.—On testing the right leg, as you see, we have a slightly spastic condition and there is a well-marked knee- and ankle-clonus. The left side shows normal reflexes. If there is any spasticity in the right arm it is too slight to make out.

We have had time to make only a very few other examinations, for, as I said to you, the patient has only just come in. A catheterized specimen of urine shows a specific gravity of 1020, a clear amber color, a mere trace of albumin, no sugar, no casts, and an occasional leukocyte. A white blood-count shows 6000 leukocytes. We have not had time to make a complete differential examination, but a quick look at a smear showed apparently normal relationships.

Now let us investigate his speech. The friend who came in with him, and who has been acting as interpreter, states that he spoke perfectly well and showed no impairment of intellect when he last saw him; that is, before the onset of the present trouble. He says he understands English very well, but does not speak it well. It is very evident from the way the patient has responded to our simple commands in English that he understands them, even though he may not grasp them as readily as a well man would. The interpreter states that when he talks to him in Polish he understands perfectly, and signifies by signs that he understands everything, but cannot speak in answer to questions. When asked if he is normally right handed, he nods "yes," but because of the paralysis of the right arm we cannot get him to try to write.

His temperature at present is 100.6° F. per rectum, pulse 88, respirations 20.

Now let us sum up the situation and see what we can make out of this case. Without any regard to the history at all we are perfectly certain of two things: First, that the patient has a right-sided hemiplegia producing a complete paralysis of the arm and leg and a paralysis of the right facial, this latter being of the superior type, that is, the superior facial being very slightly involved, the eye only a little more, and the mouth facial complete. From the tests which we have been able to make here there seems to be no question that the patient has an aphasia of the motor type which fits in with a right-sided hemiplegia. This much is perfectly clear. The second thing about which we are certain is that the patient has an old valvular lesion. The apex-beat is not only displaced outward, but is greatly widened and hypertrophied, and this, of course, is an infallible indication of an old as distinguished from a recent lesion. The auscultatory phenomena, together with the shape of the heart, make it perfectly clear that this is of the nature of a double mitral lesion. This is in accord with the rather indefinite statement of the friend that the patient had had some sort of sickness for a considerable period of time. That this double valvular lesion is now rather perfectly compensated is evident from the fact that there is no edema of the feet nor of the sacral region, nor is there any considerable enlargement or tenderness over the liver. Furthermore, the pulse-rate is not especially rapid for a lesion of this sort. It is rather interesting to note the very marked auricular fibrillation which exists. To make sure that the relatively slow pulse at the radial is not due to some of the beats failing to come through, we will auscultate the heart at the same time we palpate the radial, and in so doing we find that all of the beats actually come through.

Two other points remain to be considered: one is the fever which the patient has at the present time and the slight enlargement of the spleen. While fever occasionally occurs in cerebral conditions quite independent of anything else, it is extremely unlikely that this cause alone would produce a palpable spleen. My judgment is that the spleen and the fever are infinitely more likely to be associated with the heart condition. It is not possible without further study of the case to be absolutely certain of this,

but the probabilities are, to my mind, overwhelmingly in favor of this conclusion. It is one of the commonest occurrences to have an old heart lesion, that is, an old endocarditis, flare up again, and recurrences may take place at different times. Indeed, one can almost say that this is the rule, so I have very little hesitation in saying that the case before us represents an old double mitral lesion with a recurrent endocarditis. This recurrence is the cause of the fever and the enlargement of the spleen.

These facts bring us nearer to a diagnosis of the cerebral condition. The meager information which we have seems to indicate that the onset of the condition was sudden. The patient is a young man in whom arteriosclerotic conditions can be excluded almost with certainty. The low blood-pressure and the urinary findings make it perfectly clear that he has no chronic nephritis, at any rate not of the interstitial type. The trace of albumin which he has is readily enough explainable on the basis of the infection and the fever. We can, therefore, exclude uremia without very much difficulty. Cerebral thrombosis is extremely unlikely in a patient of his age, and this is especially true as the onset was sudden, as we have every reason to believe. The low blood-pressure and the patient's age make cerebral hemorrhage unlikely. On the other hand, we have clean-cut evidence that we have a cerebral lesion of the left side producing a right-sided hemiplegia and a motor aphasia. With the undoubted evidence of an old mitral endocarditis and the almost certain evidence of a recent endocarditis before us, there can be almost no doubt that we have to do with a cerebral embolism. This conclusion is not in the least a strained one, but the most natural one, in view of all our knowledge.

To begin with, we know that the commonest cause of cerebral embolism is an endocarditis, and this is particularly the case when the lesion is a mitral stenosis, or stenosis with insufficiency. It has been stated that approximately 90 per cent. of all cases of cerebral embolism take their origin in endocardial conditions.

In regard to the location of the embolism, there can be little doubt that it is the middle cerebral artery which is involved, and presumably the main trunk; that is, before the small branches to

the basal ganglia are given off. This is the typical picture of an embolism of the left middle cerebral, namely, a right-sided hemiplegia with a motor aphasia, if the patient be right-handed, as this patient seems to be. In left-handed individuals the conditions may be reversed.

My reason for presenting the patient to you today before the case has been worked up completely is to show you how much it is possible to elicit under the conditions which ordinarily obtain in a consultation, where one sees the patient for the first time and where one is expected to express an opinion without further ado.

What can we do further to help substantiate the diagnosis or to change it? To begin with, we will make some blood-cultures and see if an organism can be cultivated from the blood. The presence of a streptococcus or similar organism would, of course, very greatly increase the probability of a recurrent endocarditis. Indeed, under those circumstances it would make it practically certain.

As to the location of the lesion and its nature, further observation may also throw light upon these points. A hemiplegia occurring after embolism is likely to clear up slightly, but not entirely. It may subsequently prove to be the case that the main trunk of the middle cerebral is not involved, but only some of the larger branches. If this should be the case the hemiplegia will clear up, in part at least—probably the leg will clear up, leaving the arm and the lower facial involved. A continuation of the fever and its becoming more and more of a septic nature would also tend to substantiate the diagnosis. All of this is, of course, mere speculation, and I will leave the diagnosis just as it stands now; that is, a double mitral lesion due to an old endocarditis with a recurrent endocarditis engrafted upon this, and an embolus of the left middle cerebral artery, probably of the main trunk. If the patient survives, which I think is likely, I will show him to you again at some future time after we have been able to work out the diagnosis more definitely.

Additional Notes Two Weeks Later.—I want to show you the patient with cerebral embolism whom I showed you first as an

emergency case two weeks ago. There has not been very much change in his condition. The hemiplegia is about the same, the leg is perhaps a little less paralyzed, in that he can move his foot and toes just a little. The arm and face show no change. He has been running more or less fever, which has sometimes reached 102° F. in the evening and gone down to 98° F. in the morning. In other words, he has shown an irregular temperature, with at times short periods of remission.

We have done some more laboratory work on the case, which, however, has not resulted in any new conclusions. The Wassermann reaction on both blood and spinal fluid has been negative, as there was every reason to expect.

What we have secured, however, since I first presented him to you is a good many additional points in his history which have been elicited through his friends who have visited him. We learn that he was in the County Hospital before; indeed, had been discharged a few weeks previously, and since then we have looked up his old history, and find that the diagnosis which was made was that of a double mitral lesion which had been in broken compensation when he came in, and which, under the influence of rest and digitalis, cleared up entirely. He went back to work, and it was while working that he developed the hemiplegia which seems to have come on instantaneously. All of these points fit in perfectly with the diagnosis which we made when I showed him to you. The patient has an old mitral lesion, and from the mitral valve the embolus was whipped off and passed up into his left middle cerebral artery.

You will remember that we noted two weeks ago that the patient had enlarged and inflamed tonsils and that he then had a moderate degree of fever. This fever, as I have already said, has increased since then, and it is not at all improbable that this tonsillitis is responsible for the recurrence of the old endocarditis. Another fact points strongly to the steady development of a fresh endocarditis, and that is, that the leukocytosis has increased. The leukocyte count is now nearly 19,000 with a preponderance of polymorphonuclear neutrophils. The thing which has clinched the diagnosis until it is almost a certainty is the fact that we have

been able to cultivate streptococci from his blood. This, in my judgment, makes the diagnosis of recurrent endocarditis a certainty.

Nothing has developed which has caused me to change the diagnosis of embolism. He has not complained of any headaches and the eyegrounds are normal. There are no choked disks. We have no reason for postulating the development of a cerebral abscess.

Perhaps the most interesting and at the same time unexpected symptom which has developed in the meantime is in a different locality. You will remember that his spleen was slightly enlarged but not tender when he came in, and this we attributed to the recurrent endocarditis. For the past few days the patient has been complaining bitterly of pain in the left hypochondriac region. This came on rather suddenly, and examination showed that his spleen was enlarged to a considerably greater degree than before. It now comes down fully $1\frac{1}{2}$ inches below the ribs. It is exceedingly tender, and the patient objects rather strenuously to our examining him. The tenderness is not diffuse, but seems to be located squarely over the spleen, and when we auscultate this region we can hear occasionally a friction-rub synchronous with respiration.

How are we to interpret these symptoms? I think almost unquestionably the patient has had one or more infarcts in his spleen. In other words, the same thing has happened to his spleen that happened to his brain. Indeed, it may have been that the original increase in the size of the spleen was due to an infarct, although at that time he had had, so far as we know, no attacks of pain. It is, however, perfectly certain that following each of these attacks of pain there has been a marked increase in the size of the spleen and a considerable increase in the tenderness. It is highly probable that this is also a contributory factor in the increase in the leukocyte count. If our interpretation of a splenic infarct is correct this makes the diagnosis of cerebral embolism all the more probable.

We have watched the urine very carefully, because it is not at all infrequent for emboli to lodge in the kidney without pro-

ducing subjective symptoms, but causing a hematuria. Up to the present time, however, we have not found any evidence of this.

There is another symptom which the patient has shown in the last few days which is of interest, and that is hemoptysis. This hemoptysis has been going on for the last two days. I have just examined his chest, and find that there is a distinct area of impaired resonance over the left lower lobe of the lung posteriorly, and the moist crackling râles are a little more numerous over this area than before. There is no friction rub.

We also find that the liver, which was not palpable when I showed him to you before, can now be felt and is distinctly tender. This probably indicates a beginning broken compensation. I think I have told you in previous clinics that one of the very commonest occurrences in old heart lesions is to have the compensation break down when a recurrent endocarditis is added to the old lesion. Now that is what we have here, and I interpret this enlargement and tenderness of the liver as being due to broken compensation. There is a very great temptation to interpret the condition in the lung as due to an infarct. You may say at once that, of course, it is impossible to get an infarct in the lung from a left-sided heart lesion, for, of course, that is not the place from which a pulmonary infarct would come.

What happens is that in mitral lesions, especially with broken compensation, the right auricle becomes greatly dilated, thrombi form in it, and from these thrombi portions are broken off which produce the emboli in the lungs. I have often seen emboli from both sides of the heart at once—from the mitral valves on the one side and from the auricle on the other. In spite of the fact that conditions are favorable for this happening, I do not believe that this is what has occurred in the case before us. A much more likely explanation is that venous congestion of the bases of the lung has, with increased decompensation, become greater and led to the hemoptysis. The amount of blood expectorated has not been great, has not been associated with sudden pain or dyspnea, has been repeated a good many times, and altogether presents the picture rather of hemoptysis from beginning decompensation than that which occurs from an infarct in the lung. In many instances

the venous congestion in the lung is associated with a low-grade pneumonic process. In other words, the venous congestion leading to edema and hemorrhage in the lung forms a favorable culture-medium for any organisms which may be present, and we find patches of low-grade bronchopneumonia, the so-called "Schlaaffe Pneumonie" of the Germans.

We are now, I think, prepared to sum up the case and give a final *diagnosis* up to date, which would read: Old mitral stenosis and insufficiency of moderately high grade; added to this a recent endocarditis producing an embolus lodging in the left middle cerebral artery; multiple infarcts in the spleen; high-grade venous congestion of the lungs associated with hemoptysis.

I have not shown you this case because it represents anything very unusual, but to show you what you may expect to find in some cases in what is apparently a rather innocent valvular lesion. The points to be borne in mind in this case are: *first, the great tendency of an old endocarditis to develop acute exacerbations, especially if some intercurrent event, such as tonsillitis, develops; second, whenever you find a valvular lesion which has been in good compensation showing a disturbance in compensation with no apparent cause you must at once think of a recurrent endocarditis, especially if this be associated with an obscure fever; third, the case illustrates the liability to emboli.* The embolus in the brain produces, of course, very manifest symptoms which can scarcely be overlooked. The emboli in the spleen produce rather vague symptoms except in regard to pain. In a patient with a valvular lesion, especially if there be a recent endocarditis as well, you should always think of splenic emboli when there is sudden and violent pain with sudden enlargement of the spleen, particularly if there be a peritoneal rub over the latter organ. Do not forget to examine the urine constantly for blood, because this may be almost the only symptom of small infarcts in the kidney.

Note.—The patient's condition remained practically unchanged; the hemoptysis kept up and the subsequent course was such as to make it clear that there was a bronchopneumonia of low grade developing. The fever continued off and on, and the patient gradually succumbed to exhaustion and died about five weeks after being shown the last time.

AN ATYPICAL CASE OF GOUT

Closely Mimicking Acute Articular Rheumatism.

THIS patient has been in the hospital five times before, the first time some years ago. On the last two occasions he came in on December 30, 1915, and stayed until January 14, 1916, and then came in again in February and went out in March. He was admitted with a diagnosis of acute articular rheumatism each time.

The *first history* (December, 1915) states that he complained of pain and swelling in the joints with slight fever and with a duration of seven weeks. The left wrist became swollen first, then the ankles, and then the knees. The pain and swelling were very intense and the left knee was particularly painful. He had several severe chills followed by fever, but no sweats. His throat was slightly sore. His tonsils were removed a year and a half ago.

His bowels are constipated; he urinates three or four times at night. He drinks five glasses of whisky and four or five glasses of beer a day and has done this for three years. He smokes a great many cigarettes. He has had gonorrhea three times, the last time three years ago. He had soft chancres several years ago.

His mother and one brother died of unknown causes. His father died of Bright's disease.

Physical Examination.—Head, neck, and chest were negative. The heart tones were clear, with a little accentuation of the second aortic. The pulse-rate was 100 and the artery was hard to compress; the blood-pressure was 202 systolic, 120 diastolic.

Extremities.—Both knees were very tender and enlarged, the left more than the right. Both ankles were tender and painful on manipulation.

The diagnosis was acute articular rheumatism and chronic interstitial nephritis.

The *second history* recites substantially the same things that the first one does; the early histories that are four or five years old are very difficult to find now. The history taken in February simply states that the patient has a similar trouble of four days' duration. He is feverish part of the time and has severe chills at times. The left elbow was so sore and tender that the arm could not be straightened out; the right hand was painful and swollen. In addition, he had a well-developed bursitis.

This time he has been in the hospital only a few days, and he is running a little more temperature, as high as 100.8° F., simultaneously with pain and swelling in the knees. The urine has contained albumin in moderate quantities, with a specific gravity of 1012 to 1014, and a good many coarse and fine granular casts have been found. The diagnosis of chronic nephritis is, therefore, practically certain.

At first glance this certainly looks like a perfectly typical case of acute articular rheumatism. Let me call your attention to the fact that he has a rather suspicious looking nodule in the left ear which looks as if it had recently developed. There is no specific note on his last history as to the presence of tophi. No matter how perfectly typical the joint symptoms may be, if this nodule turns out to be a tophus it will settle the diagnosis. It may be a small sebaceous cyst, but I am going to take it out for you and put it under the microscope and find out whether it is or not. At any rate, it will give me an opportunity to show you the proper way to handle a tophus. The nicest way is to take a little piece of glycerin jelly on the blade of a penknife and warm it and then spread it on a slide, protecting it with a cover-glass. If you have a suspected tophus you can keep it in this way, and if it does not turn out to be a tophus you can throw it away. (Removes the tophus with a needle.)

Whenever you have a suspicious little nodule of this sort it is always wise to take it out and have a look at it. Sometimes it is so typical that you can diagnose it merely by looking at it macroscopically. I have now found a piece of this specimen that

is perfectly typical sodium biurate. It is astonishing how many of these cases look like rheumatism, and the diagnosis is not clear until the tophus is found. I think this one has developed recently, as it is still very tiny.

In the books the diagnosis between rheumatism and gout is easy. Rheumatism attacks the large joints and jumps about, it is said. *There is scarcely a case of articular rheumatism that cannot be imitated by gout.* We do not often see a bursitis in a case of gout, but the only clear guide and definite means of diagnosis is the finding of the tophus. This case is extraordinarily interesting, in that it shows why in some cases we do not get relief from tonsillectomies and from vaccines. I am convinced that we are constantly overlooking cases of gout. This man has been in this hospital five times before, twice on my service, and the diagnosis was always articular rheumatism. When the tophi are very small the only way you can be certain of them is to take them out, and when you find the little piece of cartilage with little needles running through it, making it look like needles in a cushion, you may be sure that the case is gout.

This man told us today that the trouble originally (*i. e.*, about five years ago) started in the big toe, and it starts there in the great majority of cases, but occasionally it begins in some other joint. The beginning of his disease was so long ago that he did not associate the disease in his knees and wrists with that in his toe. As a matter of fact, he tells me that he thought he had stubbed his toe, and so when his history was taken he denied that his present disease had ever existed in the great toe.

I do not wish to discuss the case further than this with you, but I do want to call your attention to the fact that our ideas in respect to the metabolism of gout have recently undergone considerable change. Up to very recently it was believed that, on a purin-free diet, a normal individual never showed any uric acid in the blood, whereas the gouty patient always did, and this was considered to be an essential point in the diagnosis of gout from the metabolic standpoint. A couple of years ago, with the aid of new methods, it was demonstrated that on a purin-free diet uric acid could be demonstrated in the blood of

normal individuals. To be sure, the quantity found was small, 1 to 3 milligrams per 100 c.c. of blood, but nevertheless it was there. At first clinicians were a little skeptical, but the work has been amply substantiated and we must accept it as definitely settled. In most cases, however, it seems to be true that the gouty patient shows a larger quantity of uric acid in the blood than the normal individual, but the difference is merely quantitative. At another time I will discuss the relationship existing between nephritis and gout in regard to uric acid.

CLINIC OF DR. FRANK SMITHIES

AUGUSTANA HOSPITAL

CASES ILLUSTRATING SPASM AT THE CARDIA AND CARDIOSPASM ASSOCIATED WITH DIFFUSE DILATA- TION OF THE ESOPHAGUS

Clinical Consideration of Spasm at the Cardia and Cardiospasm. Differential Diagnosis and Treatment. Preparation of Patient for Esophageal Instrumentation. Indications and Technic for Use of Bougies Upon a Silk Cord Guide. Description of Plummer's Cardiospasm Dilating Apparatus.

July 14, 1916.

THE first three cases which I wish to present illustrate spasm of the sphincter at the cardiac end of the stomach with intermittent mild dysphagia, but without consequent definite alteration in the shape or size of the esophagus. These cases are not associated with active lesions at the cardiac sphincter or in the esophagus. The spasm at the cardia is a secondary manifestation of irritation of the gastric mucosa and its nerve endings. These cases are briefly presented for the purpose of emphasizing a fourth case, an instance of well-established *cardiospasm* associated with pronounced dysphagia, in which there has supervened marked and demonstrable dilatation of the esophagus with esophageal retention.

The term "cardiospasm" is frequently misunderstood. It is commonly confused with "spasm at the cardia." The two terms are by no means synonymous. Cardiospasm is doubtless the sequel of acute or chronic spasm at the cardia, which spasm has become sufficiently pronounced as to bring about temporary and later permanent obstruction at the cardia. Diffuse dilatation of

the esophagus always follows true cardiospasm, and dysphagia with food retention of greater or less prominence is concomitant.

"Spasm at the cardia" may be entirely without symptoms. It usually causes a mild form of distress, but is not a definite clinical entity. Spasm at the cardia is usually secondary to abnormalities and innervation at the cardiac sphincter (hypertonia), primary esophagitis, gross lesion (ulcer or cancer), primary lesions of the stomach, as gastric ulcer, cancer, lesions of the gall-tract or appendix, in association with vagotonia or disease of the diaphragm or pleura. Cardiospasm may be primarily initiated by any of the factors productive of spasm at the cardia, but secondarily there occur alterations at the cardia itself, abnormal innervation of all or part of the esophagus, atony of all or groups of esophageal muscles, kinking or twisting of the esophagus, and, finally, diffuse dilatation of the esophagus associated with interference to the free passage of food to the stomach. It is quite essential that the distinction between these two types of malfunction should be grasped, inasmuch as rational therapy depends on the correct conception of the underlying causes of these ailments. Simple spasm at the cardia of itself is usually an innocuous affection. Cardiospasm is an ailment of such severity that unless it be radically treated death may result from starvation, inanition, or disease consequent upon it. Likewise it is imperative to differentiate between local or general dilatation of the esophagus associated with dysphagia as a result of primary pathologic processes (ulcer, cancer, cicatricial stricture, diverticula, etc.) of the esophagus or at the cardia.

CASE I.—This patient, a Hebrew woman, aged sixty-two, entered the hospital on account of daily vomiting and frequent hematemesis, high epigastric distress shortly after food ingestion, weakness, and weight loss (15 pounds in the last six months).

Family history and *personal history* have been without event until about two years ago. At that time the patient experienced distress in the high epigastrium about a half-hour after eating, particularly if solid foods were taken. Distress was well localized in the pit of the stomach, never transmitted in any

direction, and usually described as a soreness or pressure. Occasionally there was sour belching or water-brash. The appetite remained good. The bowels were constipated, but at no time was blood noted in the stools. About four months since, after severe physical strain, the patient experienced distress beneath the xiphoid cartilage immediately upon swallowing. The pain was usually cramp-like and lasted but a few minutes. Soon afterward regurgitation of food, particularly solid food, was noted, and in a short time food ingestion provoked painful vomiting irregularly. The vomitus frequently contained bright red blood. The patient entered a dispensary, and was advised to have a laparotomy for the relief of a gastric ulcer.

Physical Examination.—You can observe that this patient is moderately emaciated, somewhat anemic, and rather weak. There is a suggestion of edema about the malleoli and a trace of puffiness to the eyelids.

Ophthalmoscopic examination reveals an early neuroretinitis.

The thorax presents nothing abnormal except evidences of myocardial weakness.

Abdominal examination emphasizes a scaphoid abdomen with very lax musculature; the large bowel is filled with firm feces. There is an area of tenderness associated with a sensation of deep-lying resistance high in the mid-epigastrium. There are faint splashing sounds over the region of the stomach.

Vaginal examination discloses a lacerated cervix and a uterus containing many small, firm fibroids.

Rectal examination reveals a tight sphincter, internal hemorrhoids, but no enlarged glands in the rectovesical space.

When the *stomach-tube* is passed there is slight resistance at the cardia, but the tube, upon slight pressure, can be advanced directly into the stomach without marked resistance or pain. There is no twelve-hour retention, but moderate hypersecretion is present. The gastric contents are fairly well chymified and of normal color and appearance. Free HCl is 44, total 60. Microscopically is seen an excess of bacilli of the colon group. Chemical test for blood by the benzidin method is negative.

The *stool* is light in color (patient on gruel diet). The

benzidin test for occult blood and the Schmidt test for bilirubin are both positive.

The *urine* shows a specific gravity of 1024, acid reaction, a trace of albumin, and an occasional granular or a hyaline cast.

Fluoroscopic Examination.—The thick barium mixture is slightly delayed at the cardia and then passes slowly into the stomach. The material is directed rather markedly toward the left instead of hugging the lesser curvature. When the stomach is filled with the barium mixture there is seen a lesser curvature irregularity extending from 2 cm. below the cardia distally for about 5 cm. This irregularity has a somewhat crater-like central portion; its edges protrude into the lumen of the stomach about $1\frac{1}{2}$ cm. The gastric and duodenal contours are otherwise negative.

Blood Examination.—There is a mild grade of secondary anemia: the hemoglobin is 80 per cent., the red cells numbering 4,200,000, the white cells about 7000. The differential count reveals a relative lymphocytosis; apart from that there is nothing abnormal. The Wassermann reaction is negative.

Recapitulating, it would appear that we have to deal with an instance of intermittent spasm at the cardia associated with a suggestion of dysphagia consequent upon an ulcer carcinomatosum lying high upon the lesser curvature.

Under rest in bed, hot boric acid compresses to the abdomen, orthoform in 10-gr. doses by mouth every two hours, 5 drops of adrenalin solution by mouth every hour, duodenal feeding, rectal alimentation (a nutrient enema consisting of 1 ounce of 50 per cent. alcohol, 1 ounce of glucose syrup, and normal salt solution to make 240 c.c. was given by the drop method every four hours) dysphagia, vomiting, and hematemesis ceased, and the patient gained both weight and strength. How permanent this gain is cannot be stated at present, inasmuch as the apparent malignant nature of the ailment precludes constant improvement. The point which I wish to emphasize by demonstrating this case is that the dysphagia and the resistance at the cardia did not require intra-esophageal instrumentation; in fact, where there is evident malignancy such procedures are strongly

contraindicated. Fluoroscopic examination made yesterday demonstrates a freely patent cardia without halting of food and without esophageal retention.

CASE II.—*Benign Ulcer*.—The next patient, aged forty-four, entered the hospital on account of chronic dyspepsia, the chief characteristics of which are regurgitation of sour food, pain in the pit of the stomach immediately on swallowing, nausea without vomiting, and loss of 12 pounds in weight since the first of the year.

The *previous history* contains nothing of interest other than the fact that six years ago the patient had a posterior gastro-enterostomy for a supposed ulcer of the stomach located near the pylorus. The pylorus was not operatively closed. Three years ago a vicious circle developed and the gastro-enterostomy was removed and the stoma closed. At that time exploration of the stomach revealed no abnormalities. The patient was in good health until six months since, when she experienced attacks of high epigastric pain. This pain was sharp, spasmodic, frequently being described as "squeezing" or "tight." The distress was aggravated by the intake of all kinds of food, and the patient attributes her weight loss to the fact that she ate very little on account of the dread of bringing on pain. Regurgitation of sour food and liquids shortly after meals became extremely troublesome, but there was never definite vomiting. Food desire remained good. The bowels were constipated.

You will observe from the **physical examination** that we have to deal with a tired looking, moderately undernourished female. Nothing abnormal is evidenced apart from the abdominal examination. The belly is flat; the musculature thin and weak. Across the epigastrium one finds on moderate pressure an area of muscle spasm. On deep pressure there is localized tenderness midway between the xiphoid and the navel in the midline. The stomach is rather low and somewhat atonic.

Test-meal.—The stomach-tube passes freely until it reaches the cardia, where it meets rather firm resistance. A small amount of grayish fluid regurgitates alongside of the tube. As the tube is passed through the cardia into the stomach the patient com-

plains of pain and the gastric contents become streaked with red blood. The stomach shows no retention; free HCl is 18, the total 38. Microscopic examinations show nothing abnormal. The benzdin test for altered blood is positive.

Stool examination gives a negative occult blood test.

Urine examination reveals nothing abnormal.

Blood examination reveals a mild grade of secondary anemia.

Fluoroscopic Examination.—The material is swallowed slowly on account of the patient experiencing distress as the barium mixture passes into the stomach. The esophagus is in normal position. The cardiac sphincter is rather tight, so that the opaque mixture passes into the stomach slowly. About one-tenth of the barium meal is retained in the esophagus for about seven minutes. It then slowly passes into the stomach. The barium meal passes into the stomach along the lesser curvature. The gastric contour is normal in every respect with the exception of a slight irregularity, with a small outpouching or crater on the lesser curvature just below the cardia. This is a point of maximum tenderness—even light pressure producing pain. There is an irregularity of the greater curvature at the site of the old gastro-enterostomy stoma.

Recapitulating, it would appear that this case illustrates a spasm at the cardia in association with a benign, high, lesser curvature ulcer of the crater type. The spasm is so marked as to result in easily demonstrable, intermittent esophageal retention.

The patient has done very well on ulcer treatment directed along physiologic lines. On several occasions full doses of belladonna have relieved the spasm at the cardia, and twice the patient has required orthoform by mouth. Recently the cardiac lumen was investigated by the passage of a perforated olive upon a silk cord guide (see below). With comparatively little difficulty a No. 42 olive could be passed into the stomach, but any size above 46 was passed with considerable pain and some hemorrhage. This is just the type of case in which manipulation by either solid or inflatable bougie must be avoided. Frequent or careless instrumentation in instances where ulceration is located so near

the cardia as in this case, may readily produce rupture, uncontrollable hemorrhage, or irritation leading to malignant change. Certainly, instrumentation by bougies passed without the aid of a silk cord guide is contraindicated.

CASE III.—*Vagotonia*.—This young lad, aged twenty-two, entered the clinic on account of nervousness, vague epigastric distress coming on at irregular intervals, a sensation of pain or tightness beneath the sternum, irregular regurgitation of sour food, and general weakness. The past history of this patient indicates that he has always been highstrung and of the nervous type. He has been working as an elevated railroad conductor while preparing himself for a college engineering course.

His dyspepsia began about five years ago and has been persistent at irregular intervals since. The early attacks were characterized by a lump or fulness in the throat, a tightness beneath the sternum, a belching of gas (?), and a burning sensation in the epigastrium. The patient always felt worse after a period of mental or physical strain or while he was constipated. About a year ago he was persuaded to take a so-called "Weir Mitchell" rest cure in a hospital. After seven weeks of the rest cure he suffered so intensely that the treatment was abandoned and the patient went back to work suffering comparatively little discomfort. Recently the old trouble has returned. He attributes it to hard work and irregular hours. The feeling of tightness beneath the sternum has become more constant, belching and the raising of sour fluid are extremely annoying, burning in the epigastrium is more marked, and the patient is afraid to eat for fear of some much dreaded crisis.

Physical examination, as you will observe, shows a spare, undernourished, overgrown male. The panniculus is thin and the musculature is soft for one engaged in manual labor. There is a chronic rhinitis, with enlarged turbinates and a chronically infected set of tonsils. The lungs show nothing abnormal. The heart is flabby, the rate increased to 96, going up as high as 112 on mental and physical exertion; the sounds are clear and resonant. There is no arrhythmia and the blood-pressure by auscultation is systolic 82, diastolic 36.

Physically the abdomen is entirely without noteworthy feature with the exception of a somewhat large, splashy stomach.

The genitalia and rectum show nothing abnormal.

Test-meal.—The tube passed into the stomach with slight resistance at the cardia; there is no gastric stagnation, free HCl is 42, the total 60. There is no blood by the benzidin test.

Stool contains nothing unusual. The test for altered blood is negative.

Blood examination revealed a mild secondary anemia. The Wassermann test is negative.

Fluoroscopic examination demonstrates a moderately dilated flabby heart. The esophagus is not dilated, but at the second examination the opaque meal lodges just above the cardia and remains there for a few minutes. It then drops into the stomach in a normal fashion. The cardiac contour is normal. At the time that the first bolus of barium mixture reached the cardia the patient complained of high epigastric distress. This was only transitory and disappeared as soon as the opaque mixture began to pass freely into the stomach. The gastric and duodenal contours are normal and palpation reveals nothing unusual. There are no palpable tender areas over any of the abdominal viscera.

Recapitulating, it would seem that this patient illustrates a type of general nervous overexcitability and a gastric upset seemingly dependent upon increased vagus tone. There is gastric hyperesthesia and secondary spasm at the cardia without clinically demonstrable cause of a pathologic nature.

Treatment has consisted of rest with freedom from worry, limited carbohydrate, milk-free diet, and tincture of belladonna to the physiologic tolerance. The patient has been encouraged psychically. Not the least important of the psychic measures has been the forcible stretching of the cardia with the hydrostatic bougie, passed upon a silk cord guide. Recent general and fluoroscopic examinations disclose no gastric or esophageal anomalies. It is to be hoped this result is permanent, but in an individual of the type of this patient recurrence of the old or the development of some new type of distress may be expected.

The three patients which I have just demonstrated as types of spasm at the cardia due to several different causes (ulcus carcinomatosum, benign peptic ulcer, vagotonia) exhibit certain points in common—in all of these pain shortly after food ingestion or at irregular intervals was a prominent symptom. With the exception of the recent history of the first case, definite vomiting was uncommon. Regurgitation of sour food was the rule. Some resistance to the passage of a stomach-tube was encountered at the cardia, but the tube could finally be passed into the stomach. The passage of the stomach-tube was usually painful. The x-ray examination revealed normal outline of the cardia, but a certain amount of retention in the esophagus. This esophageal retention was, however, never of high degree, was always intermittent, and frequently but transitory. Improvement in all the cases was quite readily brought about without instrumentation directed toward the cardia. In the third case instrumentation was used for psychic effect.

The fourth case which I wish to present is one of true cardiospasm with diffuse dilatation of the esophagus. It will be observed that the history and laboratory findings are in marked contrast to those exhibited by the three instances of spasm at the cardia which I have just demonstrated.

CASE IV.—*Cardiospasm*.—This man, aged forty-seven, a tailor by occupation, seeks relief for chronic regurgitation and vomiting of food, weight loss (30 pounds in six months), and weakness. He has been told that he has cancer either of the esophagus or the stomach. His past history has been somewhat eventful. He had chronic bronchitis to the age of fifteen, pneumonia on two occasions as a young man, and thinks that he has had both malaria and typhoid fever. He has had gonorrhea twice, and it was said that he had lues at the age of twenty-five.

About fifteen years ago he noted that liquid foods were regurgitated shortly after being swallowed. If very coarse food was taken, it appeared to "stick" at the pit of the stomach. He was given pepsin, etc., by his physician, but received no benefit. About two years ago regurgitation gave place to the vomiting of liquid food soon after or some time after it had been swallowed.

There was never any pain on swallowing. Not infrequently the amount of material vomited appeared to be greater than the liquid which he had swallowed at a given meal. During the past six months the vomiting has become more copious, particularly the vomiting of such things as cereals, meats, and fairly solid food. Such material is frequently vomited from eight to twenty-four hours after eating. There has never been any distress upon the swallowing of any kind of food, but after a heavy meal there is a sensation of weight and fulness beneath the lower sternum, and not infrequently palpitation of the heart and dizziness. The food which is vomited is unchanged in appearance and taste, even though some of it may have been eaten the day before. Of late, morning diarrhea has been a troublesome symptom. The stools have never been clay colored, bloody, or of bad odor. The food desire remains good, but the patient has eaten less in order not to precipitate copious vomiting. During the last six months weakness, shortness of breath, and some numbness in the arms have been noted. Mentally the patient is much upset on account of the dread of malignant disease.

Physical Examination.—As you will observe, the patient appears weary, is rather markedly emaciated, and of the restless type. The skin is pale, sallow, with a trace of cyanosis about the ears and the finger-tips. There is a tattoo-mark on the left hand. It has been often stated that patients exhibiting tattoo-marks are apt to be luetic. The commonly held opinion is that during the tattooing syphilis is likely to be contracted from dirty instruments, etc. It would seem, however, that while there is a possibility of syphilis being contracted in this way, the presence of tattoo-marks throws a certain amount of light upon the patient's habits and mode of living. It will be recalled that establishments where expert tattooists hold forth are not infrequently located in questionable sections of the city; that unless a man is partly intoxicated or otherwise abnormally excited he is hardly apt to have himself disfigured with various dubiously artistic designs. Not rarely, street walkers also solicit passersby for the tattoo establishments, from which they often receive certain

rewards. It would seem that tattooing is but an indirect step in the acquirement of lues—the actual lesion is very apt to be gotten in the usual way.

The *eyes* are rather prominent. The intraocular tension is increased. You will observe that the teeth show many infected stumps and rather a high grade of pyorrhea.

The *thoracic examination* is negative, with the exception of a demonstrable myocardial weakness. The blood-pressure is systolic 76, diastolic 54. There is moderate sclerosis of the peripheral arteries.

The *abdomen* is scaphoid; there is an exaggerated pulsation of the abdominal aorta, but no evidences of aneurysm and dilatation. Upon palpation there are no abnormalities demonstrated.

The *genitalia* are negative, with the exception of an old epididymitis.

Rectal examination discloses a moderately large prostate of the simple hyperplastic type. There are no other abnormalities.

The Reflexes.—Gait and station are normal, Babinski is normal, and cremasteric is normal. The knee-jerks are exaggerated, particularly on the left, and both elbow-jerks are moderately exaggerated. The skin reflexes are normal.

When a stomach-tube was passed following an Ewald meal there was prompt regurgitation of the test food along the tube. The tube could not be passed beyond the cardia. The regurgitated test-meal was shown to be neutral to dimethylamidoazobenzol, apparently indicating that the test food had not entered the stomach. Tests for blood and bile were negative. Microscopically, no evidences of fermentation (yeasts) or malignancy (Oppler-Boas bacilli) were seen.

Stool examinations showed chronic duodenal indigestion, seemingly due to deficient pancreatic secretion. The Schmidt bichlorid test was positive for bilirubin. Benzidin tests for altered blood were constantly negative.

Blood examination gave hemoglobin 95 per cent., red blood-corpuscles 4,760,000, and white blood-corpuscles 9120. The stained smear demonstrated no abnormality of the red blood-corpuscles. The differential count of leukocytes was: small

mononuclears, 23 per cent.; large mononuclears, 5 per cent.; transitionals, 5 per cent.; polymorphonuclears, 65 per cent.; and basophils, 2 per cent. The *Wassermann* reaction was negative.

Urine examination disclosed nothing abnormal.

Fluoroscopic examination, with the patient standing, demonstrated obstruction to the barium meal at the cardia. At the end of ten minutes but a small portion of the opaque medium had entered the stomach. The esophagus was uniformly dilated.



Fig. 99.—Case 4. Röntgenogram made laterally showing cardiospasm associated with general diffuse dilatation of the esophagus. Note the regularity of the contour of the cardia and of the esophagus, and the indentation on the anterior surface due to pressure of the great vessels above the heart. Observe that none of the opaque meal has entered the stomach after five minutes. (Augustana Hospital plate, Leopold Blum, Technician.)

It measured 8 cm. in width at the level of the sixth rib and, seen laterally, had a diameter of 6 cm. at the same point. *The esophageal contour as well as that of the cardia was regular throughout*, thus excluding stenosis due to ulcer, malignancy, kinks, or scar-tissue. *Plates* confirmed these observations (Fig. 99).

The stomach could not be filled on account of the esophageal retention, but could be demonstrated to empty normally and to exhibit no irregularities in outline.

The *aortic arch* was enlarged, *stiff*, and *irregular*—luectic aortitis (?).

Recapitulating, it is evident that we have to deal with a dysphagia due to stenosis at the cardia. This stenosis appears to be due to no common pathologic lesion (ulcer, cancer, cicatrix). This is demonstrated by the regular contour of the esophagus and cardia as revealed by the röntgenographic examination. The stenosis is seemingly due to hypertrophy of the normal cardiac sphincter, apparently brought on (as the clinical history indicates) by persistent contracture or spasm extending over ten or fifteen years. Associated with the stenosis at the cardia is an extensive, diffuse dilatation of the entire esophagus. Other clinical and laboratory examinations indicate a chronic pancreatic insufficiency and an enlarged, stiffened aorta.

Diagnosis of Cardiospasm. Of 34 cases which have come under my observation, in but 5 instances had the possibility of cardiospasm been considered. I take it that the reason why a disease syndrome with such alarming and distressing manifestations is wrongly diagnosed and treated is simply due to the fact that the ailment is not generally known to exist, and its incidence has not been sufficiently emphasized by clinicians and textbooks.

The cases coming under my observation have commonly been diagnosed as ulcer or cancer of the esophagus, cardia, or stomach; as traction or pulsion diverticula, or cicatricial stenoses due to traumata or forgotten disease (lues, tuberculosis, typhoid fever, etc.). These mistakes in diagnosis have naturally led to unnecessary surgery, improper medical care or instrumentation, and, not rarely, to unwarranted emaciation and suffering (nay, even death) on the part of the patient.

The *age incidence* in our cases has been between twenty-five to forty-five years.

Sex.—Males have been affected more commonly than females—a ratio of 3 to 2.

The *entering complaints* have been dysphagia, copious regurgitation, or vomiting (often painless) of undigested food, weight and strength loss, and constipation (the rule).

The *dysphagia* has commonly been of somewhat abrupt onset, and, as distinguishing it from the dysphagia associated with ulcer or cancer of the cardia or the esophagus, *the inability to retain liquid food while solids were usually well borne* was a fairly constant complaint. Liquids are often regurgitated or vomited promptly after swallowing; so suddenly, in fact, that patients not infrequently are compelled to rush from the table to avoid accidents or embarrassment. Except in the early intermittent stages of the ailment *pain* is not a pronounced symptom. Not uncommonly sensations of tightness, fulness, or heaviness are experienced; occasionally sharp, sudden twinges of pain in the "pit of the stomach" or beneath the breast bone are noted. This *absence of pain* is a prominent accompaniment of the dysphagia, and is of great value in differentiating cardiospasm with diffuse dilatation of the esophagus from spasm at the cardia (associated with actual lesions at or near the cardia), ulcer or cancer of the esophagus, esophagitis, cicatricial stenosis, or stenosis due to extra-esophageal pressure. When organic disturbances (ulcer, cancer, fissure, etc.) are associated with dysphagia, pain is actually caused by the ingestion of food, whether vomiting follow or no. Liquid food is well borne to the last, while hard or solid food early causes pain and emesis. The opposite is generally true in cardiospasm.

Vomiting and *regurgitation* occur early in true cardiospasm—much earlier than where dysphagia is due to other ailments. The vomitus is generally copious and painless. Food is ejected unchanged, and the mixture is commonly neutral in reaction and free from blood or bile staining. Liquids generally come up soon after their ingestion. Solids may remain down for hours or even days, depending on the size of the esophageal sac. Such vomiting is readily confused with vomitus from gastric retention, associated with pyloric stenosis. In the latter event, however, hydrochloric acid is apt to be present, or such abnormal findings as lactic acid, blood, or Oppler-Boas bacilli may be discovered.

Weight loss is generally constant and pronounced in true cardiospasm. It averaged rather more than 20 pounds in cases in my series. Rapid weight loss (in one case, a physician,

65 pounds in less than four months) may be alarming and lead to dread of a malignant process. Clinically, however cachectic or starved such cases appear, they never give the impression of emaciation *plus* intoxication which cancer patients exhibit.

Strength loss occurs as a noticeable feature in some instances of cardiospasm. However, it is not the rule. Many patients who show great weight loss exhibit remarkable activity phys-



Fig. 100.—Stenosis at the cardia due to malignant ulcer. Note the irregularity of the contour of the lower esophagus and of the cardia; the partial filling of the stomach, and but moderate, incomplete dilatation and filling of the esophagus. (Augustana Hospital plate, Leopold Blum, Technician.)

ically and mentally. The fear that malignancy exists is not unlikely a factor in giving the impression of weakness.

Constipation is the rule. This is doubtless due to deficient food ingestion, particularly imperfect retention of liquid foods.

Röntgen Findings.—These are quite characteristic. The esophageal, cardiac, and gastric outlines are normally maintained, with the exception of diffuse, symmetric, often fusiform dilatation of the esophagus. This dilatation commonly involves the entire esophagus. The sac may hold as much as 3 to 4 liters. Pressure upon the heart, great vessels, or at the root

of the lungs may be marked. There may be associated palpitation of the heart, or dyspnea may be early and pronounced. Occasionally there is displacement of the heart to the left. It is queer, however, how extensive a dilatation of the esophagus may exist without cardiac displacement or marked pressure signs.

The röntgenographic examination readily aids in differentiating cardiospasm with diffuse dilatation of the esophagus from traction diverticulum, pulsion diverticulum, stricture associated with ulcer, cancer or cicatrix of the esophagus, stenosis due to



Fig. 101.—Immense pulsion diverticulum of the esophagus. Röntgenogram made anteroposteriorly. Note huge sac, lying to the right above the heart and extending backward—the position occupied by nearly seven out of ten diverticula of this type. (Augustana Hospital plate, Leopold Blum, Technician.)

foreign body, extra-esophageal pressure (aneurysm, mediastinal tumor, large heart etc.), or primary disease of the stomach, left lobe of the liver, cyst of the pancreas, or retroperitoneal neoplasm. Some of these points in differentiation are shown by the x-ray plates before you (Figs. 100 to 104).

Treatment.—I have already demonstrated several methods of handling instances of annoying spasm at the cardia. In such cases you will have observed that successful treatment of this condition demands attention to the prime cause (fissure at



Fig. 102.—Malignant stenosis of the esophagus. Lateral Röntgenogram. Note the stricture at the middle of the esophagus, with dilatation of the viscus above. Observe that the opaque meal passes freely into the stomach from the lower esophagus. (Augustana Hospital plate, Leopold Blum, Technician.)



Fig. 103.—Syphilitic, tortuous stenosis of the esophagus. Lateral Röntgenogram. Note several points of constriction and irregular esophageal contour. (Augustana Hospital plate, Leopold Blum, Technician.)

the cardia, ulcer or cancer, vagotonia, cholecystitis, diaphragm irritation, etc.).

If spasm at the cardia has produced intermittent cardio-spasm with but slight dilatation of the esophagus, removal of the underlying cause or causes of this spasm often cures or relieves the ailment. When there has occurred true hypertrophy of the cardiac sphincter and secondary dilatation of the esophagus,

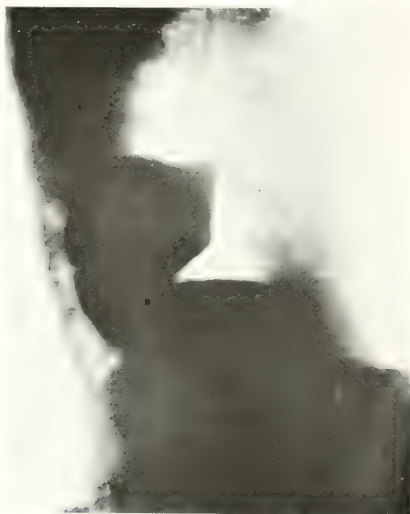


Fig. 104.—Immense dilatation of the esophagus, secondary to simple stenosing ulcer at the cardia. Esophagus holds more than 4 liters. Lateral Röntgenogram. Note great extent of sac, sharp angulation behind heart, impression of great vessels above heart, and irregular contour of upper esophagus (mediastinal infiltration due to old inflammatory disease). (Augustana Hospital plate, Leopold Blum, Technician.)

then no treatment that does not include direct instrumentation at the cardiac orifice is of permanent service. Such instrumentation means the employment of guided dilating (or divulsing) bougies. Treatment by the passage of ordinary olives or sounds is generally useless. It is also dangerous. The sounds or olives rarely pass into the cardiac orifice. As Plummer has shown (Figs. 105 and 106), such instruments commonly impinge upon the right or posterior wall of the esophagus and then pass downward,

pushing the esophagus before them in the form of a blind sac. In a greatly dilated atonic esophagus this sac may be depressed several inches below the level of the cardia. If this occurs the impression is readily conveyed to the operator that he has entered the stomach, and is further emphasized by the distance of the bougie tip from the teeth or the emesis of retention contents. Such retention contents can, however, be readily shown to be

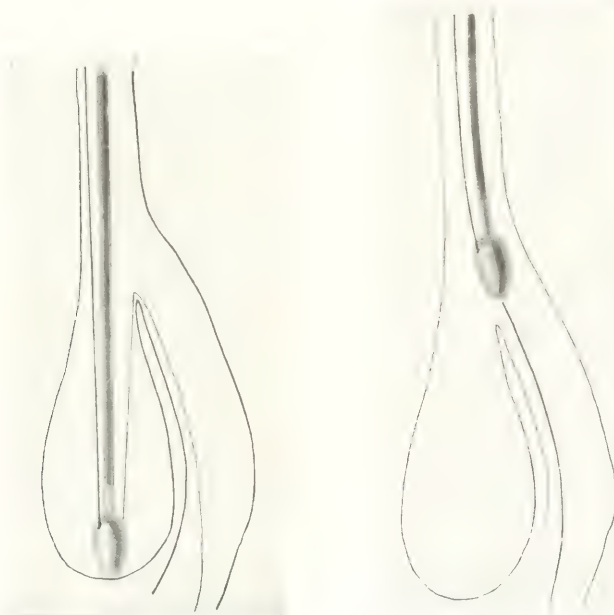


Fig. 105.—Diagrams taken from Plummer to illustrate direction of olive-tipped bougies when passed into the esophagus with and without the aid of silk cord guide.

alkaline and free from bile coloring. Sounding after this fashion is dangerous because the unguided bougies may easily injure the lax esophagus wall; they may produce ulceration or even perforation.

Following the example of Mixter, Plummer, and Lerche, *I have made it a practice never to explore an esophagus in an instance of dysphagia without the employment of a waxed silk thread as a guide for the instruments.*

The *silk thread guide* is furnished by crochet knitting-silk (Richardson's No. 20) which has been rubbed through parowax thoroughly. A length of from 6 to 8 yards is employed. During the afternoon and evening previous to the intended examination the patient is directed to swallow 6 to 12 inches of the waxed thread at frequent intervals until about 4 yards have been swallowed. Small sips of hot water aid in the

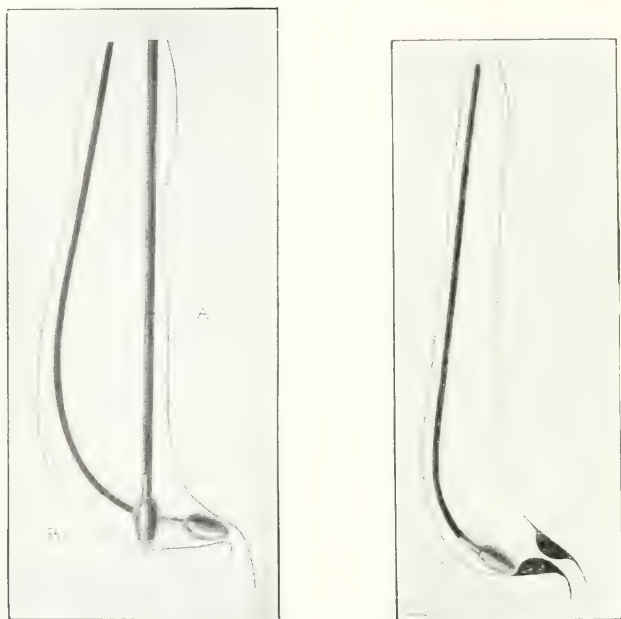


Fig. 106.—Diagrams taken from Plummer to show the direction taken by unguided bougies when passed into a sacculated esophagus secondary to obstruction at the cardia.

thread passing the pharynx and upper esophagus. The patient is cautioned not to permit the waxed thread to tangle or knot. The following morning, 2 or 3 yards of thread are swallowed rather rapidly. If the waxed thread is given after this fashion, the distal end passes well into the small gut and becomes engaged, thus permitting strong traction. The thread swallowed upon the morning when the patient is to be examined generally furnishes a knot-free section, permitting free passage

of bougies or dilators into the stomach or even into the duodenum. The waxed thread will pass anywhere that water will, and upon its being drawn taut supplies a direct guide through any stricture or stenosis. Instrumentation is thus rendered comparatively safe, certainly much safer than when bougies, etc., are passed blindly into the esophagus. Only recently a patient presented herself to my service with a fistula between the esophagus and the right pleural sac. It had followed the passage of an unguided bougie in an attempt to dilate a malignant esophageal stricture. The patient subsequently died from a pyopneumothorax.

Preparation of the Patient for Esophageal Instrumentation.—Nothing but the waxed thread and small swallows of water should be taken by mouth for eight hours previous to instrumentation. Nutrient enemata (alcohol-glucose-normal-salt-solution formula) may be administered during this period if the patient is weak or experiences much thirst.

Before the passage of instruments into the esophagus the cardiospasm sac (or any other sac) must be lavaged till it is food free. Failure to heed this precaution may result in difficult instrumentation or aspiration of esophageal contents into the bronchi.

Instruments.—Perforated olives of the pyriform type suggested by Plummer (Fig. 107) are threaded upon the waxed thread. The proximal end of the thread is drawn upward until the thread is taut. The olive is passed in boldly, yet carefully, directly to the cardia in order to make sure that there are no kinks or knots in the silk-thread guide. While olives may frequently be passed directly into the stomach through a tight cardia, yet, therapeutically, they have little place in the treatment of cardiospasm. Their use should be limited to the dilatation of cicatricial stenoses. If the silk thread is found to be knot-free, then the stretching or divulsing bougie may next be used. There are many types of dilating bougie, but the arrangement devised by Plummer (Figs. 108 and 109) has proved most useful. As you will observe, this bougie is made up of silk and elastic bags carried upon a perforated, olive-tipped, whalebone

staff, about which is a strong rubber tube connected with a pressure gauge attached to an ordinary water-tap. This hydrostatic arrangement permits of harmless, graduated stretching of stenoses. The pressure exerted is uniform in all directions and always under control of the operator. The bougie is swallowed

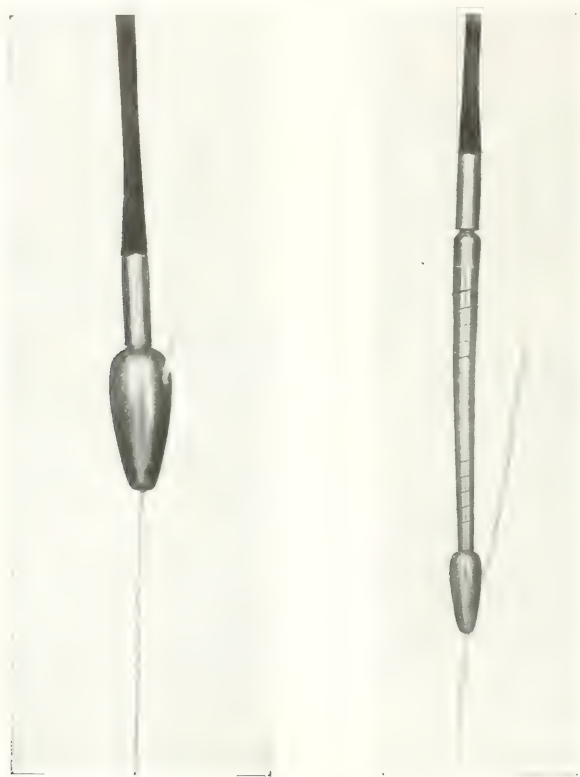


Fig. 107.—Plummer's perforated esophageal bougies threaded upon silk cord guide.

or passed quite readily. In patients with sensitive pharynges I spray the throat previously with a solution of 5 per cent. cocain.

As you observe, the bougie passed directly to the cardia on the silk thread (passing hydrostatic bougie); I now advance it carefully through into the stomach, meanwhile keeping the thread

guide very taut. The water is next permitted to flow into the silk-rubber bag until the pressure-gauge indicates 12 pounds. The degree of pressure used varies. Sometimes as little as 6 or again as great as 18 pounds is used. Above 18 pounds there is



Fig. 108. — Plummer's hydrostatic guided bougie for dilating cardiospasm.



Fig. 109. — Plummer's cardiospasm dilating apparatus complete, showing silk-elastic balloon, connections to water gauge and to water-tap.

danger of rupturing the cardia or the esophagus. Below 6 pounds but very little actual dilatation is possible. I usually allow the pressure to be increased gradually, taking about one minute's time to distend the bulb in the cardia. I leave the distended bulb *in situ* for three minutes, and then, releasing the

pressure, gradually allow the bulb to collapse before withdrawing it. As you observe, the patient experiences comparatively little pain or signs of shock; $\frac{1}{4}$ grain of morphin combined with $\frac{3}{50}$ grain of atropin is now given hypodermically. The patient goes to bed at once.

After-treatment.—Rectal feeding is instituted for twenty-four hours. This is followed by the hourly administration of 2 ounces of carbohydrate, milk-free gruels given warm for two days. After the third day the patient is given a soft, meat-free diet. Before each feeding he is required to chew paraffin wax for fifteen minutes. This promotes free flow of saliva, initiates normal swallowing mechanism, and aids in relaxing a cardia that has a tendency to spasmodic contracture. Medicinally, 10 drops of tincture of belladonna are given to the point of physiologic tolerance.

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